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## THE MANAGEMENT OF CANCER OF THE NASAL SINUSES.\*

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Cancer of the paranasal sinuses is not frequently encountered in otolaryngological practice. These tumors constitute less than 1 per cent of the cases seen at the Brooklyn Cancer Institute. During 1937, there were five malignant tumors of the sinuses among 737 admissions. Most of these cases are seen when the disease is far advanced and therefore present special problems. Fear, ignorance and the unfortunate circumstance of the absence of symptoms are factors in the late appearance of these patients for treatment. Fortunately, in many cases, a late diagnosis does not mean a hopeless prognosis. These neoplasms are usually out of sight and are frequently painless. When pain occurs it may be referred to the alveolar process, suggesting a dental condition, or it may be referred to the cheek, suggesting an antrum suppuration. Irrigation of the antrum may be negative or may reveal the presence of pus. When blood or sanguineous material are returned with the irrigation, the diagnosis is fairly certain. If a malignancy of the antrum is suspected because of the symptoms or because of the Roentgen findings, the interior of the sinus should be examined by means of an exploratory opening.

Tumors which involve the ethmoid region, regardless of their origin, may become inoperable at an early stage because

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of extension into the cranial cavity. Patients in whom this condition is allowed to progress present a pitiful sight. It behooves us therefore to make the diagnosis early and to be fearless in our attempts to secure a cure. Any neoplasm which has not yet involved the intracranial structures should be given the benefit of our efforts.

The maxillary sinus is the most frequently involved of all the sinuses. Its neoplasms may originate from the oral or nasal structures. Most of the tumors of this region had caused a prominence of the cheek when first seen by us. A majority of the neoplasms are carcinomata. Sarcomata are also seen in the maxillary cavity, principally the lymphosarcomata and fibrosarcomata. It is generally agreed that lymphosarcoma should not be attacked surgically or by electrocoagulation. X-ray and radium therapy are preferable for this type of neoplasm. Fibrosarcomata are slow-growing and therefore the hope for ultimate cure is good.

Many excellent papers have been written on the subject of malignancy of the sinuses, notably those of New,<sup>4</sup> Barnes,<sup>1</sup> Greene,<sup>2</sup> Ohngren,<sup>5</sup> and Spencer and Black.<sup>6</sup> The main purpose of this paper is to discuss the management of malignant neoplasms of the maxillary sinus in particular and to call attention to the value of radical surgery in the more advanced cases. Surgical resection of the maxilla for cancer is being criticized and avoided. It is claimed that the patient is subjected to too great a shock and that the results do not justify this procedure. Barnes emphasized the fact that resections are frequently performed by general surgeons who have little knowledge of the paranasal structures. The result is that this group of tumors is not handled as thoroughly as it might be. The procedure of opening into the antrum by way of the canine fossa for the eradication of malignant neoplasms, as advocated by New, is not applicable to the more advanced cases, such as are being discussed in this paper. New's procedure is excellent for the moderately advanced and smaller growths, but external incision is required for the type of growth represented in our cases. Resection of the superior maxilla should include only that part which must be sacrificed in order to eradicate completely the neoplasm.

This operation can be done in a relatively short period of time and with practically no shock when carried out under local anesthesia. The operation, when so performed, is not

bloody, the bleeding being readily controlled by packing. It is unnecessary to ligate the external carotid artery preliminary to the operation. In some cases it will be found unnecessary to remove the lateral nasal wall or the palatal process. When the neoplasm extends into the infratemporal fossa, the sphenomaxillary fossa, the ethmoid area or the orbit, dissecting instruments are supplemented by the diathermy electrode. The coagulating electrode penetrates tissues which cannot be properly treated surgically. If the orbital cavity has been invaded, the eye must be sacrificed in order to destroy completely the malignancy. When coagulation will not accomplish eradication of disease, radium should be applied, preferably at the time of operation. A case in which these principles were observed was operated upon 10 years ago.<sup>3</sup> The patient had an extensive lesion of the maxilla, orbit and ethmoid. He is at present alive and well. All of the maxillary sinus cases reported in this paper were subjected to X-ray therapy before they were treated by the otolaryngologist. The previous X-ray treatment neither influenced the progress of the growth, nor did it seem to interfere with the healing of the postoperative wound.

The following cases illustrate some of the problems which cancer of the sinuses suggest:

*Case 1:* A colored male, age 49 years, was first seen July 6, 1935, at the Kings County Hospital. He presented a large prominence of the left cheek and alveolar margin. He had noted this mass two years before; it had slowly increased in size. A year before the bone had been scraped at a dental college. There were no symptoms which were referable to the local lesion. Biopsy revealed the presence of a fibrosarcoma. On the X-ray film the mass was seen to extend from the canine fossa to the malar prominence. Examination disclosed the skin and subcutaneous tissues freely movable, the ethmoid orbit, nasopharynx and cervical lymphnodes to be uninvolved. There was no evidence of a metastatic process. For two months immediately after admission he received X-ray therapy. This did not influence the growth. He was readmitted in September because of bleeding from the alveolar margin. Early in October a fairly large sized sequestrum was discharged from this area. The pain in the cheek of which he had been complaining immediately subsided. During the following month, however, he lost 18 pounds.

Because of the resistance of the new growth to X-ray and radium therapy, surgery was decided upon. On Dec. 3, using local anesthesia, the left superior maxilla was resected. The resected neoplasm was reported as fibrosarcoma. The patient made an uneventful recovery and was discharged 22 days after operation. Despite the loss of the upper jaw, he was able to swallow almost immediately after the operation. At the present time he is free from symptoms and is wearing a prosthesis to overcome the loss of the jaw.

*Case 2:* A white male, age 45 years, was admitted to the Cancer Institute, April 29, 1937. He complained of pain in the right cheek bone. There was a prominence of the right nasomaxillary region and the right nasal passage was narrowed by a continuation of this prominence. An elevation could be seen in the floor of the nose, 2 cm. from the mucocutaneous juncture. A fungating mass was present in the right upper alveolar process. This appeared to be continuous with the lesion just described. The cervical glands were not involved. The Roentgenologist reported that there was involvement of the right side of the maxillary sinus. The alveolar lesion proved to be a squamous-cell carcinoma. X-ray therapy in the form of 200 radon units was given daily until 2,000 radon units were used upon the involved parts; 2,000 radon units were also applied intraorally. A biopsy performed in October revealed the presence of cancer.

In Nov. 4, an operation was performed for eradication of the cancerous area. The maxillary sinus was inspected through an anterior window and found free from involvement. The cancer was found to occupy the intermaxillary bone and to extend into the floor of the nasal chamber and the right lateral nasal wall. After resection of the involved bone, the base of the lesion was coagulated. A good part of the undersurface of the upper lip was found to be involved. Two months later, 6,000 radon units of X-ray were used for a recurrence in this area. The lesion was completely eradicated. Recently, the dental department has fashioned a prosthesis to overcome the intermaxillary defect.

At the present time the patient is comfortable and free from his cancer. Although the X-ray study suggested disease in the antrum at operation, the carcinoma was found in the adjacent bone and soft tissues, but not in the antrum.



*Case 3:* A white female, age 67 years, was seen, Oct. 2, 1933. At that time she had a mass in the roof of the left side



Fig. 1. Case 3. Photograph of patient showing prominence of left cheek and upper jaw, with displacement of the nose to the right.

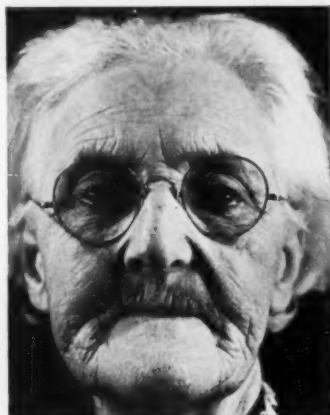


Fig. 2. Case 3. Photograph of same patient after removal of neoplasm involving the alveolus, hard palate and maxillary sinus. Note re-establishment of symmetry.

of her mouth, which had been present for four years. The mass was firm and nodular, and extended into the nasal cavity

of the same side, so that the septum was pressed over to the right and the external nose deviated. The tumor was removed by means of an exposure through the gingivobuccal sulcus by Dr. Schmidt. It proved to be a chondroma. The patient was discharged and observed in the out patient department. She was free from trouble until June, 1937, when she noticed a swelling of the left cheek. She returned in October. At this time the external nose was deviated to the right and there was a hard, globular prominence of the cheek about the size of a lime. The overlying skin was uninvolved. The left nasal passage was completely obstructed and the hard palate presented an irregular ovoid prominence. Under local anesthesia,

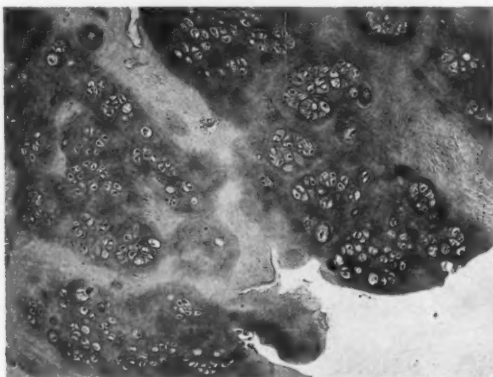


Fig. 3. Case 3. Photomicrograph of removed tumor showing typical cartilage cells distributed in nests in a hyaline stroma.

the mass was completely removed. It was found to have eroded the lateral aspect of the middle turbinate and to have extended into the nose for a distance of one and one-half inches. The bony hard palate was almost completely lost on the left side. The laboratory reported the tumor to be a chondroma.

*Comment:* Although this is not a malignant tumor, it is reported to indicate the extent to which a chondroma may develop and the problem it may present in this region. Thorough and complete removal are necessary if recurrence is to be prevented.

*Case 4:* A white boy, now age 25 years, presented himself 12 years ago, complaining of difficulty in breathing through

the right side of his nose, and occasional bleeding. A polypoid mass was found obstructing the right nasal passage. This was removed by snare and electrocoagulation by Dr. Schmidt. The laboratory report was: Granulation tissue. Two months later, because of excessive bleeding, electrocoagulation was again employed. The vision of the right eye was now impaired and an optic atrophy was found. Two months later, an exophthalmos developed. Radium was implanted into the orbit. A year later, a course of X-ray treatments was given. In January, 1929, the eye was enucleated and a diagnosis of fibrosarcoma was returned by the laboratory. He was treated at several different hospitals, where a large amount of X-ray and radium was used. In January, 1935, he was readmitted to the hospital. At this time the right side of his face was more prominent than the left. X-ray study suggested a malignant tumor of the right maxilla. Polypi removed from the right nasal chamber proved to be angiomatous. In August, 1937, biopsy from the polypoid tissue in his nose was reported as squamous-cell carcinoma. Despite the severely atrophic and sclerotic condition of the skin of his face, radical resection was advised. This was refused. Recent X-ray study revealed a marked involvement of the right nasal cavity and all the paranasal sinuses, with destruction of the medial wall of the maxillary antrum and of the floor of the orbit. There was also some destruction of the lateral wall of the right antrum and the walls of the frontal sinus; the sphenoidal walls were all somewhat eroded. The patient is still under observation.

*Comment:* This is the case of a child, age 11 years, whose trouble began with a neoplasm, which first made its appearance in the nasal cavity and orbit. At first it was diagnosed as a fibrosarcoma. Several years later, a diagnosis of squamous-cell carcinoma was made. The progress of the neoplasm has been held in check by tremendous doses of X-ray and radium, but after 14 years it is involving all the accessory nasal spaces of the affected side. Microscopic study shows the tissue to be angiomatous and degenerated in most areas, while there are occasional scattered cancer cells.

*Case 5:* A colored male, age 61 years, was first seen Oct. 29, 1937. For the past eight months he had a swelling of the left cheek. This was associated with occasional pain, which was more or less constant and radiated to the ear. Examina-



Fig. 4. Case 5. Photograph of patient indicating extent of fibrosarcoma of the antrum.

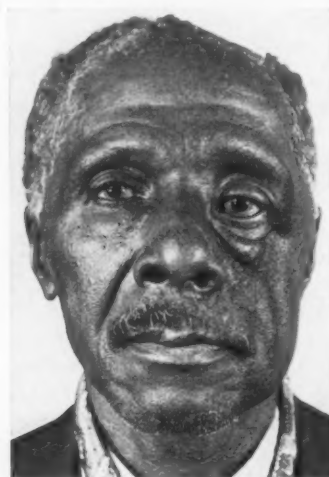


Fig. 5. Case 5. Same patient after resection of superior maxilla and coagulation of remaining neoplasm in orbital region.

tion revealed a large, smooth swelling extending to the left malar region from the lateral aspect of the nose. This was

tender to touch. Biopsy revealed a fibrosarcoma. On Nov. 16, a radical resection of the tumor and its immediately surrounding healthy tissue was undertaken. A modified Moure incision was used to expose the underlying maxillary structure. The growth extended into the subcutaneous tissues anteriorly and the lateral nasal cartilage was slightly involved. The maxilla was removed but the mucous membrane covering the palatal process was left intact. The abnormal tissue was found extending into the floor of the orbit; for this, the diathermy electrode was used. Later, X-ray therapy was given

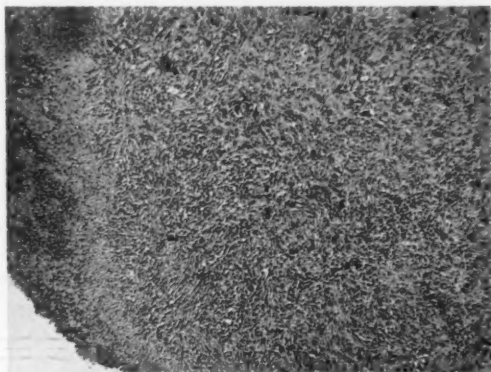


Fig. 6. Case 5. Photomicrograph of low magnification showing typical fibrous stroma with round and spindle cells scattered throughout.

for the infraorbital lesion. At the present time the patient is comfortable and has a movable left eye, with fairly good vision (see Figs. 4, 5 and 6).

*Case 6:* A white male, age 81 years, was seen at the Kings County Hospital, Dec. 31, 1937. During the past three weeks he had noticed a swelling of the right cheek, which was associated with gradually increasing pain. He presented a hard prominence of the right cheek, which was tender. An ulceration and fistulous tract into the maxillary sinus were noted in the right upper alveolar region. On the X-ray film there was a dense shadow in the right maxillary sinus, with evidence of erosion of the superior and external borders of this cavity. The laboratory report of the biopsy was epidermoid carcinoma. He refused surgery but consented to X-ray therapy.

Operation was decided upon because the X-ray treatment had no effect upon the neoplasm.

On Feb. 8, the left maxilla was resected under local anesthesia. A large tumor mass was found filling the maxillary cavity and extending into the malar and infraorbital areas. The growth was removed in a single mass. Bleeding was negligible. The remains of the infraorbital region were coagulated with the diathermy electrode. The patient did well the first few days after operation until, on the twelfth, he became psychotic. Six days later, he rolled out of bed, so that he sustained some injury and shock. Five days after this mishap, there was evidence of a bronchopneumonia, to which he succumbed.

*Comment:* This patient would very likely have died because of his general debility, but it is interesting to note that he withstood the operation very well.

*Case 7:* A white female, age 50 years, was admitted Feb. 10, 1937, complaining of a growth in her forehead. She had experienced a dull aching sensation in this region during the past year. She presented a small cystic prominence about the size of a hazel nut in the center of her forehead. This sac-like structure was easily reduced and was pulsating and tender. She had no symptoms. The ocular muscles and the eye structures were uninvolved. The X-ray film presented a cystic area of the frontal bone occupying most of both frontal sinuses, with some erosion of their anterior walls. The X-ray diagnosis was osteochondroma or giant cell tumor. A subsequent X-ray study suggested the diagnosis of osteomyelitis.

On Feb. 19, a horizontal incision was made across the forehead through a natural crease in the skin, and the soft tissues were reflected downward. A mass was encountered occupying both frontal sinuses; it was strongly adherent to the dura. The tumor was removed from its attachment to the dura with great difficulty by means of sharp instruments. Both frontal sinuses were completely removed. The resected specimen was  $2 \times 1\frac{1}{2} \times \frac{3}{4}$  inches; it was bluish gray in color. On section the diploei were thickened and whitish. Microscopic examination showed a mass composed of densely packed, oval and spindle-like cells lying in an interlacing fibroblastic stroma. The general architecture suggested either a fibro-

blastic sarcoma or a meningioma. The slides were studied by several pathologists, who were of the same opinion, but favored the diagnosis of meningioma.

At the present time the patient is comfortable and free from evidence of recurrence.

*Conclusions:* Small or moderately advanced malignant tumors of the maxillary sinus are best treated by the methods advocated by New, Barnes and Greene. Exposure, either external, through the face (Barnes) or intraoral removal (New), with the aid of cautery or diathermy and, where necessary, the application of radium. The advanced tumors in which there is marked prominence of the cheek should have the benefit of external exposure and resection. Resection should be only as extensive as the growth requires and should be supplemented by diathermy and the application of radium whenever indicated. Several experiences are cited.

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## CHRONIC FRONTAL SINUSITIS. A NEW ENDONASAL SURGICAL APPROACH.

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The multiplicity of surgical procedures for the attempted relief of persistent frontal sinusitis in itself suggests their inadequacy. Every rhinologist is almost constantly haunted by the spectre of unrelieved patients who have left the operating table with adequate surgical endonasal ostia only to return six months later with bony or fibrous stenosis and recurrent symptoms. Further surgery serves only to create new additions to the already impressive group of surgical nihilists among the general medical advisers, as well as the discouraged laity. This seems to be the only too frequent experience after the extensive external operation, as well as the various ingenious intranasal manipulations. The only outstanding exception to this situation appears to be the obliterating collapse operation, which, unfortunately, is so deforming in the large sinus usually present in serious frontal disease that both patient and surgeon rightfully hesitate until everything else possible has been tried.

A brief historical resumé might not be amiss to depict the progress in frontal surgery to date, thus revealing the innumerable modifications with their respective advantages and disadvantages. Vesalius<sup>11</sup> first described the frontal, maxillary and sphenoid sinuses, but both Fallopius and Vesalius credit Galen as the first to have noted the existence of the accessory nasal sinuses. In 1564, Ambroise Pare<sup>12</sup> warned against opening the frontal sinuses while trephining the skull in the treatment of fractures of the frontal bone, "because they were filled with a white, sticky fluid, as well as air." Morgagni<sup>13</sup> referred to Lettre as having conceived the idea of trephining the frontal sinus as early treatment of the diseases of the frontal sinus until the latter part of the nineteenth century. About 1890, Schaeffer<sup>14</sup> proposed draining the frontal sinus through the nose. He was the first to open it endonasally between the middle turbinate and the septum, using a firm and flexible probe, 2 mm. in diameter. His method will be

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best given in his own words: "If I desire to probe the frontal sinus or search for the location of complaint, I use a firm but flexible brass probe, 2 mm. in diameter, after previous cocaineization of the soft parts along the back of the nose between the septum and middle turbinate. I direct the probe upward toward the forehead. A light crackling, like the breaking of fine pieces of bone, is soon heard. It is well, then, to palpate to confirm the resistance. The probe is pushed further, and finally, when the probe suddenly glides quickly forward, the operator has the sensation of reaching a cavity, and two to four teaspoonfuls of fluid are evacuated."

Spieß<sup>15</sup> has performed the operation by the Schaeffer method with an electric trephine under control of the Roentgen screen and he praised the reliability of the procedure. In 1891, Baumgartner,<sup>16</sup> Monatz,<sup>17</sup> Greenwald<sup>18</sup> and others wrote on the subject of the diseases of the frontal sinus. About the same time, Winkler and Scheier<sup>19</sup> demonstrated by anatomical studies the surgical relation of the frontal sinus to the upper air passage, proving that it was practical to approach the frontal sinus by intranasal route; however, the drift of opinion for many years seemed to have been toward the external route. In 1884, Ogston<sup>20</sup> operated on the frontal sinus by an angular incision. A vertical incision was made along the wrinkles of the eyebrows, which met a horizontal incision parallel to the wrinkles of the brow. The Luc<sup>21</sup> type of operation was similar to Ogston's and it has been referred to as the Ogston-Luc operation. Luc, however, employed curettage and inserted an intranasal drain. Kuhnt<sup>22</sup> devised his operation, which consisted merely of removing the anterior wall of the frontal sinus. About three years later, 1898, Riedel<sup>23</sup> developed his collapse operation, which entailed the removal of both anterior and inferior walls. The latter method has been quite acceptable, except for the poor cosmetic result. At the turn of the century, Jansen<sup>24</sup> inaugurated a procedure in which he made the incision along the margin of the orbital ridge, opening the sinus from below and removing the entire orbital roof and also enlarging the nasofrontal duct. In 1895, Killian<sup>25</sup> described his type of incision through the eyebrow and preservation of the upper orbital arch. By prolonging the incision down below the inner angle of the eye, he obtained exposure, permitting curettage of the anterior and posterior cells of the ethmoid and the sphenoid sinuses. In 1908, Skil-

lern<sup>20</sup> introduced a modification of the Jansen procedure. The principles of the operation were to spare the anterior wall but to obtain the requisite space by resecting the superior internal portion of the margin of the orbit and floor of the sinus, thus exposing the entire lower portion of the frontal sinus.

About 1911, Ritter,<sup>27</sup> Jacques<sup>28</sup> and Luc<sup>21</sup> reported favorable results from an operation in which the whole anterior wall of the frontal sinus was preserved, and only the lower, or orbital, wall was removed. During this period many surgeons, such as Ingals,<sup>29</sup> Casselberry,<sup>30</sup> Skillern<sup>26</sup> and Halle,<sup>9</sup> advocated the intranasal approach. In 1914, Lothrop<sup>31</sup> described his modification of the external operation. Two years later, the technique of Beck's<sup>32</sup> osteoplastic flap was published. In 1921, Lynch<sup>33</sup> brought out a variation of the operation advocated by Ritter, Jacques and Luc, which, in his experience, had proved satisfactory. Howard and Lothrop<sup>34</sup> undertook a more radical operation. After removal of the anterior wall of the frontal sinus, they enlarged the ostium frontals by means of a curved burr and opened the septum between the frontal sinuses, together with the thickened bony edge which forms the base of the septum between the frontal sinuses. This mass of bone consisted of: *a.* The upper part of the nasal bone; *b.* the frontal process of the superior maxilla, and *c.* the anterior wall of the frontal sinus and the uppermost part of the nasal septum. In addition to the establishment of a wide canal, mucosal regeneration in the curetted frontal sinus was expected to form from the normal side. Seibilleau,<sup>35</sup> after widely opening and curetting the diseased frontal sinus and the anterior ethmoidal labyrinth, removed the interfrontal septum, along with a portion of the upper part of the nasal septum, so that both frontal sinuses emptied freely into the nose. In order to keep the nasofrontal duct open after the Killian operation, Seiffert<sup>36</sup> transplanted the skin of the thigh upon the wound area of the periorbital epithelial flaps.

It is our purpose in this paper to analyze the causes for the failure in the various nondeforming procedures and to suggest a new endonasal operative procedure devised by one of us (F. E. S.) that should avoid these pitfalls.

The prime surgical principle in the treatment of chronic suppuration anywhere in the body is aeration and drainage for immediate relief. Thereafter, where the disease occurs in

anatomical cavities the development of a new healthy epithelial lining and the maintenance of a patent ostium also lined by healthy epithelium would be the ideal end-result; however, where the disease has been so chronic and extensive that the entire epithelial structure has been destroyed, so that there remain no islets of residual epithelial tissue that may start this regeneration, we must hope for obliteration of this diseased scar tissue and eventual bony replacement. In the latter instance, the maintenance of a patent duct is superfluous and one of the external obliterating operations is a procedure of choice. In soft tissue this obliteration by granulation collapse occurs rapidly; also, in other bony areas, where the cavity is not anatomical, healing from below upwards with healthy bone replacement is prompt, provided that the underlying disease has been completely eradicated. In the anatomical cavities, as the paranasal sinuses lined by functioning mucous membrane, this obliteration is extremely slow, if at all, even when the mucosa is thoroughly eradicated. When this obliteration does occur, it is frequently by poorly vascularized granulation tissue or scar, which offers scant resistance to recurrent infection, as noted by Skillern.<sup>41</sup> The optimum status would be as much regeneration as possible of whatever functioning mucous membrane is left in the sinus or the immediately adjacent nasal mucosa. How much membrane is present under the polypi, cysts, pyogenic membrane and scar tissue can only be determined by the test of time.

Goodyear<sup>1</sup> takes cognizance of this fact in advocating the maintenance of a large intranasal antral window for a long period of time even in the chronic hyperplastic cases before resorting to radical surgery. After such a trial a nondeforming external procedure to remove a recalcitrant pyogenic membrane can always be later performed with a minimum of danger and trauma.

Adami<sup>3</sup> states that the mucous membrane of the antrum is regenerated and is histologically normal. The regenerated mucous membrane, however, must come from islands of mucosa left at operation or grow in from the nose.

Fischer<sup>4</sup> found that cultures of epithelial tissue double their size in three or four days. In 1928, Knowlton and McGregor<sup>5</sup> demonstrated in dogs and in human beings that the mucosa of the sinuses was completely reformed after complete

removal. The new lining was essentially normal. Coates and Ersner<sup>6</sup> found that epithelium was regenerated in the frontal sinus of the dog. Hilding<sup>8</sup> states that prolific regeneration seems to be part of the physiological process of mucous membrane.

Unfortunately, contrary to the situation in radical antrum surgery, which is practically without danger and is followed by relatively few unpleasant postoperative sequelae, the external frontal sinus operation in the actively diseased frontal sinus is frequently followed by postoperative complications, despite adequate surgical skill and precaution. Here, postoperative osteomyelitis, meningitis and recurrence is too frequent to permit of the external approach before adequate intranasal surgery has been performed; nevertheless, the endonasal procedures utilized heretofore are frequently rendered valueless by the tendency of denuded bone to regenerate or sequestrate where traumatized. Stenosis seems inevitable unless we can provide a well vascularized unconstricted mucosal flap which will cover the surgically traumatized tract in its entirety, right into the sinus. If we add to this an opening large enough to permit of the removal of gross hypertrophies in the sinus, so as to allow better drainage, mucosal recovery should be facilitated. In addition, mucosal regeneration would be greatly aided if the interfrontal septum could be largely removed and the mucosa of the opposite healthy or less diseased side permitted to extend into the diseased sinus (Lothrop<sup>31</sup>).

Of all the endonasal operations, that of Hallé would seem to offer the greatest part of these *desiderata*. On closer examination of this procedure, however, we find that the mucosal flap with the base attached below only covers the site of the resected *agger nasi*, the denuded posterior edge of the frontal floor (*crista frontalis*) remaining uncovered. In addition, this procedure does not utilize the advantage of communicating both frontals via resection of the interfrontal septum.

The use of pinched skin grafts requires an additional operative procedure with frequent failure of viability because of the restricted operative area for application and the constant bath of pus from the diseased sinus above.

Before describing the operative procedure, a few anatomical data should be reviewed.

The spine of the frontal bone, which is called the crista, is usually thick and occupies the greater part of the floor of the frontal sinus. The contiguous borders of both nasal bones are prolonged backward to form a crest which rests on the frontal spine and the anterior border of the perpendicular plate of the ethmoid. The short superior borders of the nasal bones are thick at their point of articulation with the frontal spine, thus allowing for thinning anterolaterally with the burr. The following are the boundaries of the frontal sinus: anteriorly, the forehead; below, the orbit, and posteriorly, the cranial cavity. The extent of the frontal sinus varies. In the majority of cases, the upper boundary of the frontal sinus extends beyond the squamous portion of the frontal bone, only slightly beyond the supraciliary arch and reaches almost to the anterior third of the orbital roof. Not infrequently, however, the frontal sinus has much larger dimensions. It may extend far forward into the squamous part of the frontal bone; or it may reach further backward into the orbital roof. More rarely, the frontal sinus extends deeply into the nasalis superior, in which case it is partly covered by the nasal bone.

Except for a small niche, the frontal sinus may be absent.

The frontal sinus is not always pneumatized to the same extent in every direction; in fact, it may be quite irregular.

The frontal sinuses are separated from each other by a septum. This septum may be exactly in the midline, or it may be inclined to one or the other side; thus, marked asymmetry of the two halves of the frontal sinus may be produced. It is obvious that this anomaly of the septal wall, which is rather frequent, must be considered in operative attacks. It is well to remember that the lower part of the interfrontal septum shows, relatively, very infrequent deviation. The usual medial position of the lower end of the interfrontal septum is of vital import in this surgical approach. A radiogram taken in the anteroposterior diameter gives reliable information as to the width of the frontal sinuses and the position of the interfrontal septum. Another radiogram of the lateral aspect of the skull reveals the depth of the frontal sinuses and the distance from the anterior margin of the crista galli to the nasion. Beside the boundaries of the frontal sinuses, the thickness of its walls is of importance. With these measurements, we can approximately determine the extent of the beveling-off process



of the crista frontalis. If the macerated frontal bone is held in front of the light, it will be observed that the cerebral and orbital walls are translucent on account of their thinness, whereas the anterior wall is much thicker than the other two. In the sagittal cross-section of the frontal bone these walls show the same characteristics.

Deficiencies, or dehiscences, in the osseous walls of the frontal sinus are of occasional occurrence. The dehiscences of the orbital wall are the most frequent, while the cerebral and frontal walls above the supraorbital border have been found defective in a few instances.

Partial septa of varying degree frequently project from the walls of the frontal sinus. They divide the cavity of the sinus incompletely into subcompartments, some of which not infrequently partake of the nature of deep recesses; moreover, the anterior fossa at times projects into the dorsomedial wall of the sinus as a bleb-like ridge. Care must be exercised in operative procedures lest the impinging anterior fossa be broken into. The impingement of the anterior fossa is especially prominent when the dorsal portion of the intersinus septum is deviated to one side.

Before attempting surgery, a careful radiographic study is essential. A stereoscopic view will yield topographical information not available by any other means, but for our purposes is not essential, inasmuch as a lateral and a direct posterior-anterior view contain all the data required as to the safety zones in this procedure. The posterior-anterior view indicates the location of the interfrontal septum, particularly as to degree of deviation from the midline. The lateral view is of utmost importance, indicating the distance from the nasion to the anterior margin of the crista galli. This anterior margin of the crista galli constantly denotes the anterior extremity of the cribriform plate. The latter cannot be readily defined radiographically, but the crista galli stands out clearly. The antero-posterior dimensions of the frontal sinuses are only relatively proportionate to the extent of this surgical field, inasmuch as the greatest distance from the nasion to the crista galli in a series of 200 lateral films was one inch, and the smallest, one-half inch; whereas, the anteroposterior dimensions of the frontal sinus varied from zero to three and one-half inches. Fortunately, although the greatest part of



the upper interfrontal septum frequently deviates markedly to one side or the other, the base is almost constantly in the midline. Although the cases with the half-inch measurement are quite amenable to this procedure, it is preferable to restrict its use to those cases yielding a measurement of three-fourths of an inch or over. In this way we can secure a very satisfactory ostium which is one-half inch in its posterior diameter and still leave ourselves a one-fourth inch margin of safety in front of the anterior extremity of the cribriform plate.

Leonhard has demonstrated that those cases with a true sagittal diameter of less than .3 cc. are very rarely subject to severe chronic inflammation. In the exceptional case of this type requiring surgical intervention, the Riedel collapse operation is ideal because of the absence of deformity in the shallow sinus and the certainty of cure.

*Operation:* The Rose position, with the head hanging low, yields the best exposure and freedom from aspirations of blood or pus. Local anesthesia, combined with avertin, is quite satisfactory. The nasal mucosa is thoroughly shrunk with an ephedrine cocaine spray and both anterior ethmoidal nerves, as well as the upper part of the septum, are infiltrated with 1 per cent novocaine solution. Later in the operation, if the avertin is not sufficient to control the patient, 10 per cent cocaine solution can be applied directly into the frontal sinus on pledgets of cotton. The operation is begun on the side which offers the greatest air space if the septum shows a high deviation. The posterior incision (see Line 1, Figs. 1 and 2) is made from the vault of the nose through the septal mucosa downward and parallel to the profile line of the nose. The incision must be situated on a line just anterior to the tip of the middle turbinate and extends to the level of the lower margin of the latter structure (see Fig. 2). The anterior incision (see Line 2, Figs. 1 and 2) commences just above the articulation of the nasal bone with the nasal cartilage and is continued down for one-half inch in the inner aspect of the concavity formed by the articulation of the septum with the upper lateral cartilage of the nose. These two incisions are then joined (see Line 3, Figs. 1 and 2). A mucoperichondrial flap is thus elevated from the septum and is further dissected off from the vault of the nose, exposing the bony roof. If the septum is not markedly deviated to the opposite side, a similar mucoperichondrial flap is dissected on

the opposite side, except that it is made about one-fourth of an inch longer. The denuded area of the septum is then thoroughly resected flush with the inner aspect of the nasal bone articulation with themselves and the floor of the frontal sinus. If there is a marked deviation present, a submucous resection is performed from the wide side before outlining the flap on the constricted side. We thus have two partially tubular flaps formed, hanging free from the vault of the nose (see Fig. 3). An electrically driven pear-shaped burr is then placed on the crista frontalis. We find the Mueller pistol handle, devised

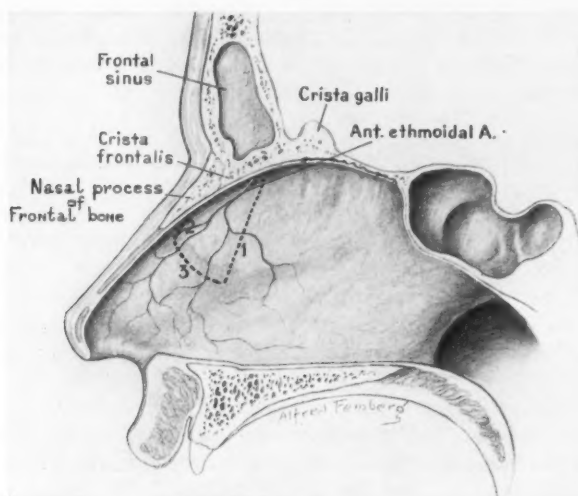


Fig. 1.

by Hallé, best adapted to this procedure. The crista and posterior surface of the nasal bones are gradually thinned anteriorly, maintaining ourselves constantly in front of a line joining the anterior tips of the middle turbinals. An external finger is kept constantly on the nasion and glabella. The drilling is continued until the rasping of the burr is palpated as periosteum is reached. The direction of the burr is satisfactorily maintained by resting the shank on the upper padded lip, carrying the handle as far down as possible. This yields effective pressure of the burr on the crista frontalis in an

anterior direction. After this region has been sufficiently beveled off, a round burr should be directed into the frontal sinuses, which should now be wide open, exposing the lower end of the interfrontal septum and the diseased contents (see Fig. 5). Because of the heat generated during the drilling the burr should be changed frequently and should be anointed with some tenacious antiseptic ointment, such as the "BIPP" (bismuth subnitrate 5I, iodoform 5II, liquid paraffin to make a paste), advocated by McKenzie.<sup>40</sup>

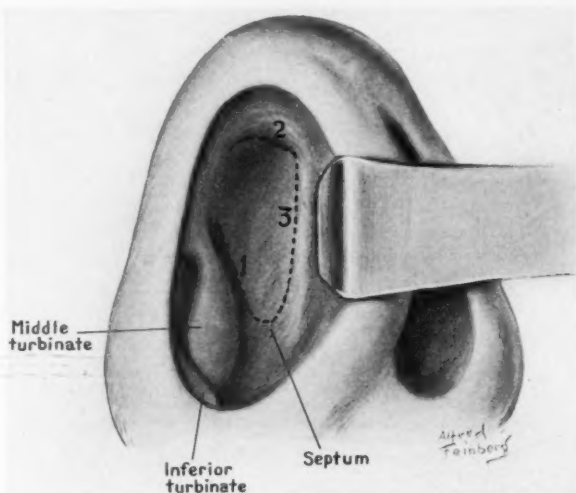


FIG. 2.

We can now enlarge the opening laterally as far as we need for adequate visualization and ventilation. The lower portion of the interfrontal septum is resected as far as possible under direct visualization, utilizing both a rounded burr and a fine sidebiting punch. As much of the presenting hypertrophies, polyps and thickened membranes as can be readily approached is removed by snare, angular dissector and blunt forceps. We have thus created a large endonasal opening into both frontal sinuses, with viable flaps hanging free on both sides, a surgical end-result quite similar to that following

the Lothrop procedure, except for the incomplete removal of the sinus contents.

The final step of this operation consists of swinging each tubular flap on its pedicle up into its respective frontal sinus so that most of the new denuded ostium is lined with viable mucous membrane (see Fig. 6), with a rich active blood supply through the intact anterior ethmoidal artery (see Fig. 1). That portion of the flap which was previously the most dependent now lies on the anterolateral floor of the frontal sinus. The lower margin of the fenestrum in the nasal septum

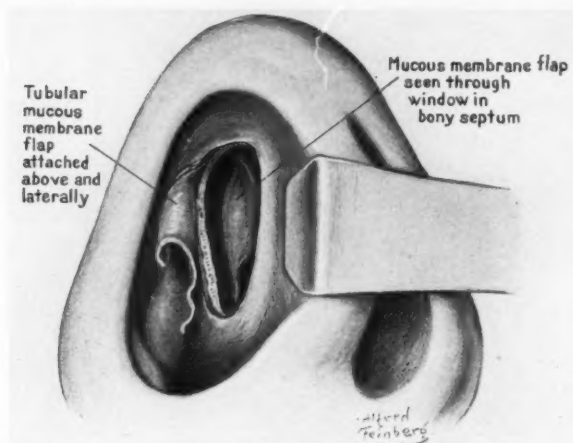


Fig. 3.

is now covered by the redundant mucous membrane of one side, provided for previously by preparing the flap longer on this side. By this means we should avoid the troublesome crusting noted in septal perforation with fibrous margins. Whistling does not occur because of the high location of the fenestrum and its large size. A light vaseline-iodoform packing to maintain the flap and assure hemostasis is advisable.

Aside from the local procedure, we also deem it advisable to eliminate thoroughly all coexisting foci of infection. This appears to be especially true of the tonsils. There appears to be a definite clinical relationship between exacerbations of

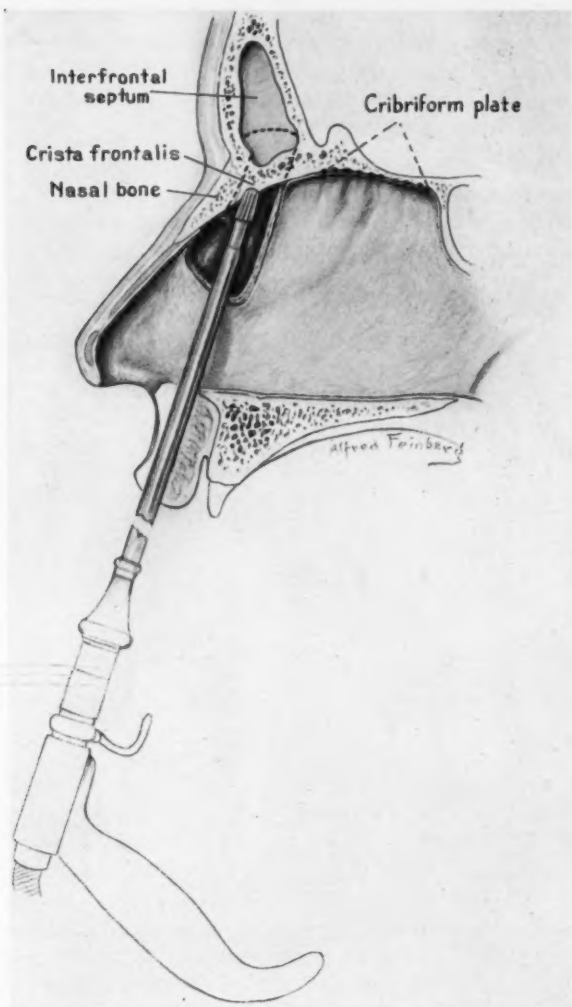


Fig. 4.

frontal sinusitis and tonsillitis. We have noticed this condition particularly in patients who have experienced recurrent attacks of phlebitis in remote parts of the body following

acute tonsillitis. It is quite possible that the diploic veins, especially after repeated insults, become as susceptible to infection as the veins in the lower extremity. We are, therefore routinely removing the tonsils, as well as diseased teeth, before instituting any operative procedure on the frontal sinus or septum.

Some of the reasons for unsatisfactory results in chronic frontal sinus surgery have been considered and a new surgical approach to the problem presented. A later paper will sum-

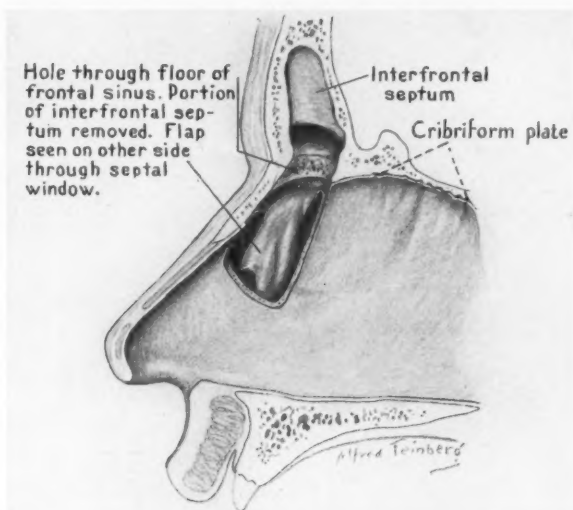


Fig. 5.

marize our end-results in several cases subjected to this operation, especially as to maintenance of the patency of the surgical opening and the regeneration of healthy sinus mucosa despite incomplete removal.

*Case 1:* S. G., male adult, age 26 years; occupation, farmer; was referred on Feb. 15, 1937, with a history of severe right frontal pain intermittently for the past six years. The day before examination, he had pain over the left frontal sinus as well, with a head cold two weeks before. He has always

had some nasal obstruction, but it has been particularly marked in the past few months.

Examination revealed a chronic suppurative pansinusitis with antra and frontals opaque to transillumination.

Sinus X-rays by Dr. L. Nathanson confirmed the diagnosis of a hyperplastic and suppurative pansinusitis. Measurement from the anterior extremity of the crista galli to the root of the nose was exactly one inch.

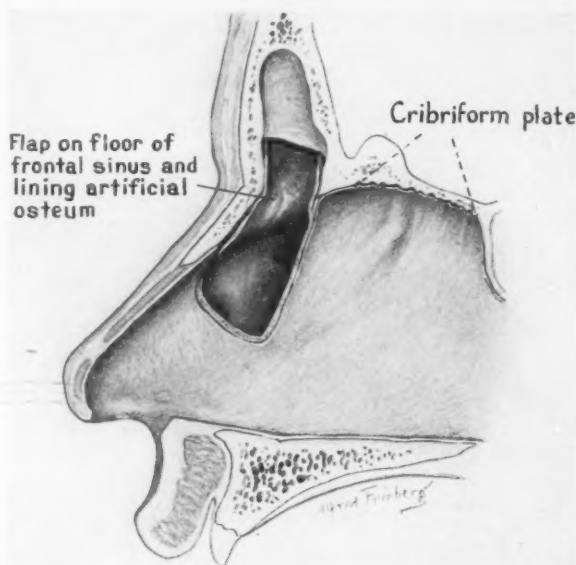


Fig. 6.

Trans-septal intranasal frontal sinus operation was performed by Dr. Frederick E. Stone. Both frontal sinuses were opened widely, creating an opening with an anteroposterior diameter slightly over one-half an inch. Both frontal sinuses were full of hyperplastic and polypoid membrane and pus. The pus was removed by suction and all the polypoid material was removed by snare and Bruening forceps. Drainage was maintained with rubber catheters reinforced with vaseline-iodoform packing.



Culture of the pus yielded a hemolytic streptococcus. Sulfanilamide accordingly was administered, and the patient made a fairly uneventful recovery, except for some cyanosis on the second day, which disappeared after the dosage of sulfanilamide was reduced.

Examination three months after the operation showed a fairly smooth opening, which has maintained its patency well; a moderate discharge from the open frontal sinuses persists and a thickened hyperplastic membrane, which appears to be improving, however, under repeated insufflation

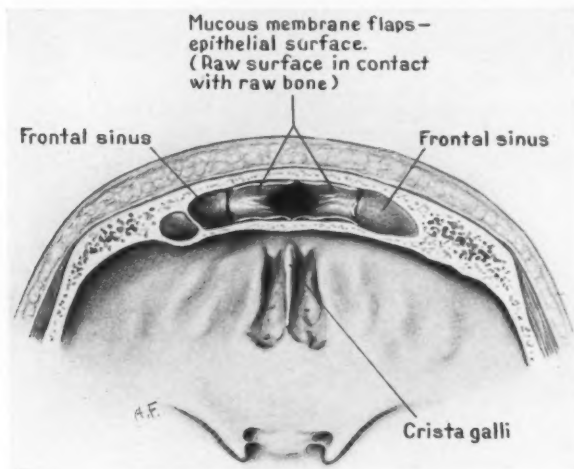


Fig. 7.

of iodine powder. There are no more headaches, and bilateral intranasal ethmoid and antrum operations are contemplated in the near future.

*Case 2:* L. C., a carpenter, age 48 years, presented himself on Oct. 14, 1937, complaining of a severe sticking pain in the right temple and frontal for about 10 years, for which he underwent a nasal operation. The pain was temporarily relieved, but recurred with the same symptoms a year ago, and has persisted with increasing severity since then. He has also suffered from a chronic bronchitis for the past 10 years,

which is somewhat better in the summer and aggravated by climatic changes. One year ago, when the symptoms recurred, patient was observed at the Kings County Hospital, where an external radical operation was recommended. This advice was rejected by the patient, who had obtained relief from the headache through the use of proprietary headache remedies almost daily.

Examination revealed a poorly nourished male adult, coughing at intervals and expectorating large quantities of light green mucopus. Intranasal examination showed a moderately atrophic process, probably secondary to a combination of chronic infection and intranasal surgery. On the right side was present a large, bright red polyp bathed in pus, obstructing the nasofrontal duct. There was marked tenderness over the right frontal sinus. The left was not tender. Transillumination showed a dark right frontal sinus and a relatively clear large left. The antra was clear. The polyp was removed from the right nasofrontal duct. It was irrigated with a small cannula in the right frontal sinus. A large amount of pus was obtained. Return flow, however, was obstructed and the patient experienced pain during the irrigation. Repeated irrigations produced no improvement in the patient's condition and surgical intervention was decided on.

X-ray study by Dr. L. Nathanson revealed tremendous frontal sinuses with marked hyperplastic pathology in the right frontal and ethmoid. The remaining sinuses were relatively clear. Measurements from the anterior extremity of the crista galli to the nasion were slightly over three-fourths of an inch.

The trans-septal frontal sinus operation was performed on Nov. 15, 1937. The left frontal sinus was relatively normal, although the mucosa was somewhat reddened and thickened. The right showed a large pyocele containing mucopurulent material under pressure. The mucosal lining of the sinus was poorly attached and much of it was easily removed by the sidebiting Bruening forceps. Drainage was with rubber catheters, reinforced with vaseline and iodoform packing. Bacteriological study of the purulent material revealed encapsulated pneumococcus type III, in pure culture.

Except for some transient edema of the right upper eyelid, convalescence has been unusually satisfactory. It is too early

to note mucosal regeneration, but the flaps are healing satisfactorily. There is very scant discharge and the patient's bronchitis appears to have definitely improved. This is particularly encouraging in view of the marked pathogenicity of the organism recovered from the sinuses.

*Case 3:* A. P., an oil salesman, age 31 years, presented himself on Sept. 29, 1937, with a history of a chronic left frontal sinusitis for the past year, without relief. The patient was very susceptible to colds; his nose was clogged almost constantly. The patient had had considerable intranasal surgery, without lasting relief, in the past 12 years.

Examination revealed marked polypoid changes on the lateral side of the right middle turbinal anteriorly; pus exuding from the nasofrontal area. The right nasal chamber is over-roomy; the nasal septum shows a large postsurgical perforation. The nasal mucosa shows a low grade, pinkish edema. There is slight deep tenderness over the inner angle of the right superorbital ridge. Transillumination shows very large hazy frontal sinuses; the antra are opaque. The antra were punctured and irrigated several times; pus returned. The frontal sinuses could not be catheterized. The patient's symptoms continued without relief, although the left antra cleared up completely and the right antrum was much improved.

X-ray study by Dr. L. Nathanson revealed unusually large frontal sinuses developed almost entirely within the vertical plate. There was a moderately thin anterior plate present and it bulged somewhat anteriorly. There was a marked opacity involving both sinuses, suggestive of exudate. Similar pathology was noted in all of the remaining sinuses. Measurement from the anterior extremity of the crista galli to the nasion is just one inch.

Right frontal headache persisted and the patient asked for surgical relief. On Jan. 8, 1938, operation by Dr. Stone was performed by the trans-septal route. Both sinuses were almost identically involved. The mucosa was tremendously thickened and the cavity was almost completely obliterated by large cystic polyps and granulomata. There was a moderate amount of thickened inspissated pus present near the midline. The patient apparently showed a susceptibility to cocaine, and further manipulation within the sinuses was discontinued because of syncope. Penrose drains were inserted into the

midst of the hyperplastic masses and the shortened flaps were brought up to cover the denuded bone. The patient reacted satisfactorily to mild stimulation and made a thoroughly satisfactory recovery. There is at present a very satisfactory operative opening present, which fills continuously with dependent polyps from the frontal sinus, and a moderate mucopurulent discharge. These polyps are being removed as rapidly as they appear and, although the frontal sinuses are still full of hyperplastic polypoid material, the patient's subjective symptoms, including the headache, have largely disappeared. In this case, if his symptoms should recur, an external window for the radical removal of the diseased contents and inspissation of the posterior wall would be indicated and would be a relatively simple procedure.

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## TREATMENT OF LARYNGEAL CARCINOMA.\*†

DR. RUDOLPH KRAMER, New York.

This study of carcinoma of the larynx is an attempt to analyze for myself the results of treatment and to determine, if possible, any indications for the selection of the type of treatment most likely to be successful in any particular case. It is true that the number of cases in this series is relatively small and in some instances the time elapsed after treatment has been too short for clear-cut conclusions. Nevertheless, some of the patients have been observed sufficiently long to evaluate the results of treatment. I am of the opinion that the general viewpoint of time elapsed after treatment of laryngeal cancer in relationship to cure is of little help in studying the results. The usual periods selected are three or five years after therapy. As a matter of fact, most recurrences, local or glandular, take place in much less than one year. In this series of cancer cases there has been no local or glandular recurrence after the first year, with one exception, which occurred 12 years postoperative. I do not for a moment deny that recurrences or metastases take place two, three or five years after operation, but they are comparatively infrequent. I am of the opinion that if patients are observed routinely by follow-up every two or four weeks, as I do with all my patients, recurrences will be noted early; long before they fall into the two- or three-year recurrence group. On the other hand, the three- or five-year period is much too short because patients do occasionally get late local or distant metastases seven, 10 or 20 years after treatment. Therefore, reliable definitive statistics on the treatment of laryngeal carcinoma can only be obtained after many years of observation, a longer period of time than any one man is likely to cover in his active medical years. There are exceptions, such as Chevalier Jackson and St. Clair Thomson, who are able to report lengthy follow-ups on their thyrotomy cases. It will

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†From the Mount Sinai Hospital, New York.

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require relays of laryngologists following the courses of therapeutic procedures for many years to estimate the value of each procedure if in the meantime the specific etiology and treatment of cancer are not discovered. For we must remember that we have not been treating carcinoma itself, but a local manifestation of a general disease or tendency. In the interim tentative reports such as this are in order so that a mass of material may be available for the study of various procedures and their indications in the treatment of laryngeal cancer.

From 1926, when I first had the opportunity of treating carcinoma of the larynx on my own responsibility, up to 1931, my opinion was that laryngectomy under local anesthesia was the best method of therapy. In that period I saw no case that I considered suitable for thyrotomy. I saw many patients who had been treated by external or internal radium applications and by the old type of Roentgen treatment with dismal and prompt failure. In 1931, Dr. William Harris, radiotherapist to Mount Sinai Hospital, persuaded me to send him a patient for treatment by fractionated protracted Roentgen therapy according to the principles of Coutard. The result in this case was startlingly good as to eradication of the disease, restitution of structure and preservation of function. After due consideration I decided to refer all cases for Coutard radiotherapy for a period of years with the exception of those cases of limited extent suitable for thyrotomy and an occasional case for laryngectomy so that the younger members of my staff might learn the operative technique and the post-operative care of laryngectomy. This year I decided a survey of results was in order.

Since 1931, all cases but two seen on my service at Mt. Sinai Hospital have been subjected to treatment either by operation or by radiotherapy according to the principles of Coutard. One of these two cases left the hospital when the diagnosis was made; the other died of an intercurrent disease before the diagnosis was made.

In addition, two patients who required laryngectomy after the failure of radiotherapy left my care and were operated by other laryngologists. These two cases are included in the statistics.



The treatment employed has been: 1. thyrotomy with chordectomy, etc.; 2. partial laryngectomy, that is, resection of part of the thyroid cartilage and the laryngeal contents; 3. laryngectomy; 4. fractional protracted radiotherapy (Courtard) (see Chart A for details of this type of therapy); 5. combinations of the above methods. I have no experience with the present-day use of radium in laryngeal carcinoma. In no case was treatment withheld because the disease was considered too advanced. All cases were treated and are therefore included in this report except two patients mentioned above.

The results of thyrotomy in carefully selected cases are best exemplified by the statistics of Chevalier Jackson and St. Clair Thomson, followed by those of Tucker, Clerf, New and others, who, after a prolonged follow-up cite, cite 80-85

## CHART A.

## Physical Factors Used for Roentgentherapy in Cancer of Larynx.

K.V.: 180-200 MA. 4-15.  
 FILTER: Two mm. Cu. or Thoreus.  
 DISTANCE: 50-60 cm.  
 SIZE OF FIELD: 50-100 sq. cm.  
 NO. FIELDS: Two lateral; occasionally one anterior.  
 RATE of "r" flux per minute, 4-15.

per cent free of disease. The statistics on partial laryngectomy are practically nonexistent. The results of laryngectomy are in a confused state. In most series in which unselected cases were operated upon, the results are 25-40 per cent free of disease. In one series reported, that of Mackenty, the results are very much better, although not stated statistically by the author. In his series of 102 cases, selection was in most cases rigidly carried out. New and Figi report 56 per cent cures after five years in 60 cases of laryngectomy. Results such as these may well form a basis for the study of the curability of laryngeal carcinoma.

The cases reported tonight are too few in number to permit of reliable statistical percentage observations. I hope you will remember this statement when I present figures or percentages, which I shall do solely for the purpose of making the relationship of success and failure easier to perceive.

In the tables there will appear more cases treated than there were patients. This is due to the fact that if one method of therapy failed, another might be tried subsequently on the same patient. The failures and successes are listed under the appropriate therapeutic procedure wherever it is possible to do so.

I have examined the data from the following standpoints: 1. histology; 2. extent of the disease; 3. location or site of origin.

The histologic findings, as here reported, may be misleading in some cases. For at times biopsy from one part of the tumor shows one type of epithelioma, whereas the larger part

TABLE No. I.

Classification of Material According to Histology—Results of Treatment.

	No. Cases	Thyrotomy No. F.O.D.*		Laryn- gectomy No. F.O.D.		X-Ray No. F.O.D.		Surgery and X-Ray No. F.O.D.	
Differentiated									
Squamous Cell .....	22	4	4	2	2	13	5	3	3
Moderately									
Differentiated .....	32	5	4	9	5	18	12	--	--
Undifferentiated .....	4	--	--	1	0	3	2	--	--
Basal Cell Cancer....	1	--	--	--	--	--	--	1	1
Total.....	59								

\*Free of disease.

of the neoplasm may be another type. Whenever possible, this has been corrected by study of the resected tumor.

*Histology:* (See Table I.) The material has been classified in four histologic groups: 1. Differentiated or mature squamous-cell carcinoma; 2. moderately differentiated squamous-cell carcinoma; 3. undifferentiated or immature squamous-cell carcinoma; 4. basal-cell carcinoma. Of 22 differentiated squamous-cell carcinomas, 13 were treated by radiotherapy; five, or 40 per cent, of these are free of disease. One Roentgen therapy case classed as a failure died two years after treatment from a recurrent coronary artery attack, with no evidence of disease of the larynx. Four thyrotomies and two laryngectomies are well. Three patients treated by surgery (one thyrotomy, one partial laryngectomy, and one laryn-

gectomy) and subsequent Roentgen therapy are free of disease.

There were 32 moderately differentiated squamous-cell carcinomas; 18 were treated by Roentgen therapy, with 12, or 67 per cent, successes; nine laryngectomies were performed, with five, or 55 per cent, free of disease; one laryngectomy classed as a failure died two years after operation for squamous-cell carcinoma of the larynx, of an adenocarcinoma of the stomach, with no evidence of recurrence of the original cancer. Five thyrotomies were done and four are well.

Four undifferentiated squamous-cell carcinomas were found. Three were radiated and two of these are free of disease.

TABLE No. II.

Analysis of Material According to Extent of Disease and Type of Treatment Employed.					
Limited Lesion	Vocal Cord		False Cord		Epiglottitis
	Free Motion No. F.O.D.	Fixed No. F.O.D.	No. F.O.D.	No. F.O.D.	
Thyrotomy .....	7	6	2	2	
Laryngectomy .....	3	3	3	0	
Radiotherapy .....	8	6	5	2	
Extensive Lesion	No. F.O.D.		1	1	2
Radiotherapy .....	18	10			
Laryngectomy .....	7	4			

One laryngectomy died of metastases. One basal-cell carcinoma was treated by thyrotomy and Roentgen therapy, and is free of disease.

*Extent of Disease:* (See Table II.) Eight cases with free motion of the vocal cords were treated with Roentgen rays and six (75 per cent) are free of disease—two to six years after treatment. One died after two years from a recurrent coronary seizure with no recurrence of carcinoma; the other failure after Roentgen therapy had a preliminary operation, apparently a partial laryngectomy, and died of local recurrence and pulmonary metastases. Seven patients were treated by thyrotomy; of these, six (85 per cent) are free of disease—one to four years postoperative. In the failure after thyrotomy, there was a recurrence on the opposite cord. This was treated by Roentgen rays and the patient is well two years

later. Three patients were treated by laryngectomy and are free of disease six to eight and one-half years after operation. I would not subject these cases to laryngectomy today.

Three other limited lesions, two on the laryngeal surface of the epiglottis and one on the false cord, were treated by Roentgen rays and are free of disease—one, three and six years later. The results of Roentgen therapy in the treatment of limited lesions of the vocal cords with free motion are slightly less favorable than the results of surgery, but the numbers given above are so small that one case is sufficient to alter the percentages significantly.

Fixed vocal cords without extensive disease—five cases were radiated and two (40 per cent) are free of disease, one for seven years, the other for two years. Two patients treated by thyrotomy are free of disease, two and three years after operation. Three laryngectomies were done and three died; one with coronary disease and postoperative pneumonia; one, one and one-half years, and one, two years, after operation, of metastases. The results of the use of Roentgen therapy in fixed cord lesions is interesting because most students of the question, including Coutard himself, state that fixation of the cord is evidence that Roentgen therapy will fail. However, two cases are free of disease, one for seven years and one for two years after treatment.

The group labeled "Extensive disease" includes cases with spread to the extrinsic larynx, some with glandular involvement, some with disease involving the thyroid cartilage or prelaryngeal soft parts. Eighteen cases of this group were treated by radiotherapy. Ten (55 per cent) are free of disease; two cases each, for one, two and four years; three cases for five years and one case treated after laryngectomy for four years. The failures after radiotherapy, eight in number, lived from four months to two years after treatment without freedom from disease at any time.

Seven cases were treated by laryngectomy and four cases (57 per cent) are free of disease, one each for four, nine, 10 and 12 years.

As a matter of interest, with reference to prognosis and operability of laryngeal carcinoma, I would like to point out that the patients living 10 and 12 years after laryngectomy

were both refused operation by well-known laryngologists. The lesions were considered too extensive for operation, inasmuch as the extrinsic larynx as well as the prelaryngeal soft parts were involved. I feel that no patient should be denied a chance for relief from his disease, no matter how hopeless the removal of the lesion may appear. There is one other case of interest in this group. In 1920, Dr. Sidney Yankauer removed the right vocal cord by suspension laryngoscopy. Twelve years later there was a recurrence in the larynx. Radiotherapy was employed with little success and because

TABLE No. III.

Analysis of Material According to Site of Origin and Type of Treatment Employed.								
	Thyrotomy		Laryngectomy		Radio-therapy		Surgery and Radiotherapy	
	No.	F.O.D.	No.	F.O.D.	No.	F.O.D.	No.	F.O.D.
Epiglottis .....	--	--	3	2	8	6	--	--
Arytenoid .....	--	--	--	--	1	1	--	--
False Cord and/or								
Ventricle .....	--	--	2	2	6	3	--	--
Vocal Cord.....	6	5	2	1	9	6	1F†	1
Subglottic .....	3	2	2	1	5	2	2	2
							1F†	
							1LP‡	
Undeterminable								
Origin .....	--	--	6	1	5	1	1L*	1

\*Laryngectomy.

†Fissure.

‡Partial laryngectomy.

the patient persistently refused laryngectomy, partial procedures were attempted unsuccessfully. The patient lived 16 years after the original cordectomy.

*Site of Origin:* (See Table III.) It is at times difficult or impossible to determine the site of origin in some cases. In some cases treated by Roentgen therapy, the site of origin is indicated, as the tumor regresses, by the residual growth near or at the termination of treatment. This is due to the earlier destruction of the daughter or younger cells and the persistence of the older or mother cells.

Nine lesions originating on the vocal cords were treated by radiotherapy. Six (67 per cent) are free of disease. Seven cases were treated by thyrotomy and six (85 per cent) are

free of disease. The one failure after thyrotomy was treated by radiotherapy and is well. One patient treated by thyrotomy was later subjected to Roentgen therapy because of a desire to insure the good result which was obtained. Two laryngectomies were done and one is free of disease. Statistically, the thyrotomy cases were more successful than the radiotherapy cases in this group, but practically all the patients treated by Roentgen rays could not have been treated by any operation short of a laryngectomy, inasmuch as these were cases involving both cords in their entirety or lesions on the posterior part of the cord with involvement, in some, of the posterior commissure. Not only is this location rather unusual in laryngeal carcinoma, but the prognosis following laryngectomy is generally considered to be poor.

Subglottic lesions were treated by Roentgen therapy in five cases, with two (40 per cent) free of disease. Thyrotomy was done in three cases, with one death, a coronary attack, the third week after operation. Two (67 per cent) are free of disease. Two cases were treated by surgery—one thyrotomy and one partial laryngectomy—followed by Roentgen therapy, and are free of disease. One laryngectomy died two years after operation, with glandular metastases. One subglottic case, treated by radiation unsuccessfully, was later operated upon by Dr. Buckley, who performed a laryngectomy and the patient is free of disease. He has had similar experiences to mine in that the healing of the wound following Roentgen therapy is exceedingly difficult.

False cord and ventricle growths were operated upon by laryngectomy in two cases with freedom from disease. Six cases were radiated and three (50 per cent) are well. One of the failures had a coronary attack two years after radiotherapy and no recurrence of cancer. Two of the irradiated cases that are free of disease had marked glandular involvement before treatment and they would not have been favorable subjects for laryngectomy. They responded very well to radiotherapy.

Epiglottic lesions were treated by laryngectomy in three instances, with two (67 per cent) free of disease. Eight cases were radiated and six (75 per cent) are free of disease. With two exceptions, all the epiglottis cases were extensive, involving the aryepiglottic folds, false cords, true cords, prelaryn-

geal soft parts, etc. Radiation therapy offers excellent prospects for good results in this group.

There were 12 extensive cases of unknown origin. Five were radiated and one is free of disease. Laryngectomy was done in six and one is free of disease; one case was treated by laryngectomy and Roentgen therapy, and is free of disease.

A summary of the treatment without regard to the above considerations shows that 31 patients were treated primarily with radiation; 18 (58 per cent) are free of disease one year or more. In seven cases radiation was employed in conjunc-

TABLE No. IV.

Fifty-nine Cases of Cancer of Larynx. Results of Treatment.*†					
	No.	1 Year or More F.O.D.	No.	3 Years F.O.D.	5 Years or More F.O.D.
Radiotherapy .....	31	18 (58%)	20	13 (65%)	11 (72%)
Thyrotomy .....	12	10 (83%)	3	3 (100%)	---
Laryngectomy .....	12	6 (50%)	12	6 (50%)	12 (50%)
Laryngectomy after Radiotherapy..	4	1 (25%)	3	1 (33%)	2 (50%)
Surgery before Radiotherapy.....	7	5 (71%)	5	3 (60%)	1 0

\*This table illustrates the fallacy of statistics when small number of cases is studied; i.e., higher per cent of cures for radiotherapy and thyrotomy for three years than for one year.

†More cases than patients, due to use of two or more procedures in some instances.

tion with preliminary surgery (thyrotomy, partial laryngectomy or laryngectomy) and five (71 per cent) are free of disease one or more years. Six out of 12 (50 per cent) laryngectomies are free of disease in the instances where this operation was the sole procedure. Ten out of 12 (83 per cent) treated by thyrotomy are free of disease. The three- and five-year results are also noted on Table IV.

There were 59 patients treated by me or under my supervision. Thirty-eight (64 per cent) are free of disease at least one year; 26 out of 42 patients (61 per cent) are free of disease at least three years, and 14 out of 24 patients (58 per cent) are well five years or more.



The following observations were made during the treatment of these patients: If the carcinoma did not disappear within two months after Roentgen therapy was terminated, this form of therapy proved to be a failure. If there was no evidence of disease six months after termination of Roentgen therapy, there was no recurrence in these cases and the patients remained well to date. In our experience there have been no one- to three-year recurrences following radiation. The failures have announced themselves shortly after termination of treatment. This is generally borne out by Coutard, Schinz, and Stuart Harrison, who have had very few recurrences after the first few months following radiotherapy.

Fixed cords, thyroid cartilage involvement and subglottic lesions are not indications that Roentgen therapy is doomed to failure, as is stated by some, notably Coutard. To be sure,

TABLE No. V.

Results of Treatment by Surgery. Roentgen Therapy and Combinations of Both.			
	No. of Cases	Free of Disease	Per Cent
One year or more.....	59	38	64%
Three years or more.....	42	26	61%
Five years or more.....	24	14	58%

they are not favorable cases, but they responded favorably in 40 per cent. If radiation is to be employed and the airway is markedly stenosed before treatment, careful consideration should be given to the nature of the obstruction and its probable response to Roentgen therapy. If the obstruction is likely to cause asphyxia during the five or more weeks of treatment, tracheotomy should be done before radiotherapy is begun. Tracheotomy during treatment causes serious delay and the interruption may result in failure. In some cases, death due to sloughing or infection may result from the intervention at this time. I have seen no fatal pulmonary complications during the course of radiotherapy in the patients we have treated.

The indications for the treatment of laryngeal carcinoma, as they are suggested, and let me emphasize "suggested," by the results obtained in this group of cases are as follows:

1. Highly differentiated squamous-cell carcinoma responds less favorably to Roentgen therapy than to surgery. If extent or site of origin of the lesion favors use of Roentgen therapy, the cytology is not then a discouraging factor.

2. Surgery and radiotherapy offer approximately equal prospects in patients with freely moving vocal cords. But if thyrotomy or partial laryngectomy can be utilized, they should be the procedure of choice because of the shorter convalescence, more comfortable postoperative course, and greater economy to the patient.

3. Limited false cord, ventricular, aryepiglottic and epiglottic lesions respond well to Roentgen therapy and unless an operation, such as thyrotomy or epiglottidectomy, is indicated, fractional radiation is preferable to laryngectomy.

4. Fixation of the cords indicates the use of surgery. But if extralaryngeal conditions intervene, Roentgen therapy offers some prospects of cure. When fixation is combined with extensive disease, Roentgen therapy and laryngectomy yield about the same results. If glands are present in addition, radiation is preferable to surgery.

5. Subglottic lesions respond better to surgery than to radiotherapy.

6. In cases of doubt as to the results of operation, Roentgen therapy should be employed as soon as the wound has healed.

After the completion of this report, I read the report of Houtant at the International Otolaryngological Congress at Berlin in 1936. His analyses and findings, based on 300 cases, are similar to those detailed in this report.

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## THE ART OF GOOD TONE-PRODUCTION, WITH SOME HELPFUL SUGGESTIONS.\*

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Physicians in general, and especially otolaryngologists, should all be very much interested in voice-production. The writer refers to *correct* voice-production; *i.e.*, good *tone*-production. A good natural voice may be regarded as a "gift of God"; but the poor voice can be improved in the presence of a larynx that is normal in its anatomy and innervation, and therefore need not remain a lifelong affliction.

The term "tone" rather than "voice" is here used intentionally to designate the vocal sound which is pleasing to the ear, and has good carrying power. We all possess a voice naturally, but not all of us are capable of expressing ourselves verbally or in singing with a clear, resonant, far-reaching voice. The importance of good tone even in ordinary speech, and more especially in public speaking, can hardly be exaggerated. The benefits therefrom affect favorably not only the audience in that it hears better and listens more attentively, but in addition, the subject-matter is put across more effectively. And, finally, there is a reflex benefit felt by the speaker himself—a stimulating reaction upon his "Ego."

Good voice production has for many years been a topic for study, investigation, and discussion among singers, speakers, physiologists, physicists and teachers of vocalization. And yet this subject was (and perhaps still is) in a chaotic state, not only for the lack of agreement among scientific investigators, but also because of the differences and contradictions among teachers or vocal trainers themselves.

There have been various theories to explain how the vocal cords produce voice, how the *good* voice is obtained, and a variety of methods for training the voice; all because of the ignorance on this subject. Most good singers gave evidence

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of their exceptional voice before they came under the influence of, or sought guidance from, professional vocal trainers. Their voices were *not* the product of any personal "method," or any teacher's "system." When these individuals in later years began to teach others, each utilized the particular system which he had found(?) efficacious in his own self. Just as no two persons are identical, so the methods employed by the various teachers were different, except in some details. By the aid of newly devised instruments and technique, investigators have in recent years shed new light upon the role played by the pharynx, the neck muscles, in good tone production. The writer in this paper will suggest a treatment for improving voice, based upon anatomical grounds.

It has been customary for the medical man, when attacking this subject, to adopt the scientific approach employed in the study of other organs of the body. How fallacious the results have been as concerns the voice is realized when we listen to the average lecturer on medical topics. He dissected the larynx to study its intimate anatomy; he investigated its mechanism to learn its workings as a sound-producing apparatus, and he brought into play his knowledge of the physiology of the larynx and laws of physics. All this was well enough, but seemed to fall short somewhere. Just as there are excellent automobile drivers who are wholly ignorant of the internal mechanism of the auto, so also are there persons who instinctively produce excellent tones without possessing knowledge of the laryngeal anatomy or physiology, or physics. But persons so gifted do not as a consequence possess also the ability to teach others how to make the necessary adjustments in a poorly functioning vocal apparatus. Special study and observation are essential to train a teacher.

Therefore, instead of proceeding along conventional lines and repeating here the recognized details in the anatomy, physiology and physics of the larynx itself, it may be better to enumerate rather the disputed points pertaining to this subject. For example, do the vocal cords function as vibrating strings or as vibrating reeds? Should the soft palate be up or down in good tone production? Which are the more important resonators to enhance the sound of the voice, the supraglottic or infraglottic, and how to bring them into play? Three different registers of the voice are described, but how

were they produced, and was it proper to develop one register to displace the borderline tones of the next one? Different types of breathing were described, but without accord on the method applicable to all. The function of the soft palate, if any, in controlling head resonance; the function of the false cords; the manner in which the vowel sounds were formed by variation in the oral cavity by action of the tongue and lips, all these were additional points of controversy.

That the vocal cords were of themselves incapable of producing the loud tones we hear, if they be regarded as vibrating strings, was recognized long ago; and it was found necessary to establish a function of resonance in a system of resonators comparable to those we are familiar with in musical instruments. Later critical minds figured that these resonators did not meet the specifications according to the laws of physics, if they really served the purpose attributed to them. When the upper part of the head was removed so that the larynx was without a roof, sounds produced through it were louder than when the dome over it was *in situ*. As a consequence the head and oral cavity must be regarded as mufflers or modifiers of the voice rather than as resonators. And so also with the chest.

G. Oscar Russell, working under the auspices of the Carnegie Institute of Washington, investigated this subject very thoroughly by the aid of new instruments and hitherto undeveloped apparatus, and although he admits there is more to learn, he has brought to light some revolutionary facts. His laryngo-periskop produced photographs of the larynx in action without interference with the function of the tongue, mouth or pharynx. In addition, X-ray photographs of the larynx at  $1/120$ th of a second frequencies, showing its movements during phonation, coupled with oscillographs of the larynx, head, chest, and stroboscopic observations of the vocal cords, along with co-ordinated sound-reproducing mechanism and photographic records of the subject undergoing the study, all have brought to light factors concerned in tone production which are at variance with former conceptions. These investigators have shown that the vocal cords produce sound *not* by vibrations, as do strings in a musical instrument, but by repeated puffs or explosions of the air released from the trachea by the rapid opening and closing of the valve-like action of the

vocal cords. Hence the term "vocal labia" now occurring in literature seems to be the correct name instead of "vocal cords." They function just as do our lips when playing the trumpet, cornet, or similar instrument. Russell and his collaborators concluded that variations in pitch are not produced by changes merely in length of the vocal cords (which would be the case if they were vibrating strings); that the chest is not a resonator when "chest" tones are produced, and that the head is not a resonator when high notes with "head" resonance (so-called) are produced. Yes, the chest, the head, do separately and collectively lend their respective timbre to the tones in question, but they are not resonators as we understand resonators. They found that at all times it was in the larynx itself that the maximum vibrations occurred, and oscillographic tests of chest, head, etc., proved other parts vibrate in a lesser degree than the larynx. However, be assured of this fact—the vibrating column of air that emerges from the larynx must pass unimpeded from the neck and out through the mouth. Low tones are produced not by relaxed, elongated cords vibrating, but by a marked reduction in the size of the laryngeal outlet by approximation of the cartilages of Santorini and Wrisberg, with that bulge or cushion (pulvinar) at the base of the epiglottis, aided also by a loose approximation of the ventricular bands. This arrangement also served to produce the guttural type of voice. When a harsh, strident tone was emitted the false cords came more actively into play, and there was formed at this time a rigid muscular tube just above the true cords; even the geniohyoid and mylohyoid muscles being involved in this rigidity. This tone is harsh, unmusical, and eventually damaging to the voice.

THE ANATOMICAL PARTS WHICH CONTROL THE POWER AND  
TYPE OF VOICE.

The anatomical parts which co-operate in producing a voice of a particular power and quality are then the trachea, which varies in length and calibre as well as in its cartilaginous structure; also the size and structure of the laryngeal cartilages; the intrinsic as well as the extrinsic muscles of the larynx; by no means overlooking the pharynx—that tube through which the blast of air travels after it has left the vocal cords. For this tube is collapsible, and serves as a damper capable of choking off an otherwise good voice. The

same is true of the size of the faucial space, the oral cavity. Viewed from above in a head that has been sawed off above the level of the tongue, the pharynx is seen as a flattened tube, with the base of the tongue for its anterior wall and the front of the cervical spine as its posterior wall. By drawing forward the tongue and lower jaw, this tube opens and develops a more rounded aperture. Looking down into this the epiglottis is seen almost a few inches lower, practically in contact with the posterior wall of the pharynx. It is readily comprehensible that the epiglottis must also play a very important part in modifying and directing the air column. The character of the muscular tissues which constitute the walls of this supraglottal tube, as also the degree of expansion which it can undergo, and the manner in which the base of the tongue falls back against the pharyngeal wall, all control the size of the column of air as well as its vibratory quality. The character of the mucosa lining this tube is a factor not to be ignored. If it possesses a tendency to dryness because of imperfect mucous glandular activity, it naturally impedes the progress of the air blast and, secondarily, can hinder the behavior of the muscular walls.

The three registers of the human voice are somewhat comparable to the three speeds in the mechanism of the automobile. For that series of low tones which are known as "chest" tones, one type of adjustment of the laryngeal parts is required. For the succeeding series of tones as the scale is ascended a change in adjustment (gears, if you please) is required; and for the higher series of notes known as "head" tones, a still different adjustment (or gear) is employed. The shift from low to the middle or mixed register occurs usually between the notes G and A, while the shift from middle to high register occurs usually in passing from E to F in the upper octave. In the relaxed position the cricoid cartilage rests at the level of the fifth cervical vertebra; but we must remember that the fifth vertebra may be so narrow or flattened that the intervertebral disks of the vertebrae both above and below may also be in contact with the cricoid. Or the cricoid may be seen resting against the fifth and part of the fourth vertebra, or at a lower level. It is stated that the vibrations of the chest are aroused by the contact of the cricoid with the vertebra, and since in the lower register the laryngeal vibrations are at their widest or coarsest range,



their impact against the lower cervical spine is more energetic than in the higher registers. In addition, it is demonstrable in the opened cadaver that the low position of the larynx requisite for low tones also favors the directing of the blast of air against the interior of the thyroid cartilage and the base of the epiglottis attached thereto. That is the result of the manner in which the rima glottidis faces, because of the tilt in the relative position of cricoid with thyroid. But the position of the larynx requisite for the next series of tones (mixed register) is somewhat higher in the neck, the rima glottidis is now tilted to a more horizontal direction, and the stream of air emanating from the glottis is apparently divided, part being directed against the epiglottis and upper part of the thyroid cartilage, part passing on upward toward the palate and base of the skull. Finally in the position which the larynx assumes for the production of the higher or "head" tones, the elevation of the larynx is still higher and the natural rotation of the thyroid cartilage moves it, as well as the epiglottis, out of the path of the column of air, which now is directed upward toward the nasopharynx and soft palate, developing head vibrations. Our experience in mirror laryngoscopy bears out these remarks concerning the rise of the larynx and the removal of the epiglottis from obstructing our view of the glottis.

G. Oscar Russell's elucidation of what occurs in the larynx, pharynx, oral cavity, and tongue and lips proves that all these parts participate in vowel formation—in fact, the larynx and pharynx play so important a role that the tongue and lips can no longer be regarded as the chief actors. In his book, *The Vowel*, Russell states that the vowels may be divided into two classes, judged by the adjustment of the laryngeal parts. One class is related to the laryngeal adjustment required for the production of brilliant or lustrous tone, the other being related to the adjustment required for the dampened or mellow tones. But the pharynx takes an active part also in assisting the larynx to impart to the tone the brilliant quality or the mellow one. The vowel E as in "peep" most effectively enlarges the pharyngeal pouch in its antero-posterior dimension. In forming the vowel A as in "pap" the narrowest pharyngeal space is presented. Also the walls of this pharyngeal pouch assume either a relaxed state, as for mellow tones, or a more tense state for the metallic or lus-

trous tones. The vowels are graded in a series, depending upon the state of the larynx. In pronouncing the sound of "Ee," one sees the laryngeal aperture widest open, the epiglottis is farthest from the posterior part of the larynx, with its movable cartilages, while the aryepiglottic folds are elevated and sharpened. As one proceeds to utter next the "I" sound as in "pip," then "A" as in "fame," then "E" as in "pep," lastly "A" as in 'map," the pulvinar at the base of the epiglottis has moved more and more toward the cartilages of Santorini, and the aryepiglottic folds have lost their sharpness, which makes for a softer but narrower glottic aperture, and therefore a mellower, less metallic tone. Similar changes occur as the larynx passes from the metallic tone (with a clang) to the mellower or dead tones. When "Ah" as in "pop" is sounded, the tongue is pushed back against the epiglottis, which is pushed toward and almost against the cartilage of Santorini and arytenoids, closing off a view of the larynx. In saying "Oh" as in "pope," the tongue and epiglottis move slightly forward, still giving almost no view of the cords. Likewise the lower the tone in most vowels, the more the upper aperture of the larynx is closed by the combined action of the epiglottis, false cords, arytenoids and Santorini's cartilages.

The position of the soft palate has been found to be raised high in most excellent singers, and yet it does not interfere with proper head resonance. This also contradicts an old conception. The unhampered laryngeal vibrations are communicated also, presumably by way of the cervical spine, to the roof of the mouth and teeth. In humming, one may learn good voice production when he can at will incite the best vibrations in the teeth. Freedom of laryngeal vibrations is hampered by tenseness or contraction of the tissues, mainly muscular, which hold the voice box in its position in the neck. These consist of the bands of muscles that stretch from the front of the sternum upward to the thyroid cartilage, and thence up to the hyoid bone. These are the sternohyoid, sternothyroid, thyrohyoid muscles, not omitting the sternomastoid muscles even, since in many short necks these greatly overlap the thyroid cartilage and hinder its vibration. In addition, we cannot ignore the muscles which connect the hyoid bone with the base of the skull. These include the stylohyoid, digastric, mylohyoid, geniohyoid. Finally, and very

important, are the muscles which, as it were, strap the voice box backward against the cervical spine—the middle constrictor of the pharynx attached to the hyoid bone, and the inferior constrictor attached to the sides of the thyroid cartilage. If these muscles are tight they compress the voice box against the cervical spine, particularly if the spine has an exaggerated anterior curvature at this site, or if the head is placed at a slightly posterior position as it rests upon the spine, also if the front of the chest is flat. These anatomical features are worth remembering, since voice production can be improved by overcoming these antagonistic agencies.

#### SUGGESTIONS FOR GOOD VOICE PRODUCTION.

One of the important functions of the larynx is its silent but very positive function as a valve. Closure of this valve is accompanied by an elevation of the larynx and a tenseness of the muscles concerned in this role which interfere with voice production. Every bodily effort or muscular strain, even if involving other parts of the body, is accompanied by closure of this valve in the glottis. Dr. E. L. Kenyon phrases it thus—"that in all animal functions of the body the thyroid cartilage and hyoid bone are drawn upward tensely against the base of the tongue. The trachea and larynx are moved upward *en masse* in these functions." This he determined in his reported investigations upon the larynx by palpation of the laryngeal cartilages in its various functions. We know that this high position of the larynx is maintained during the phase of the valve-closure of the glottis, as in swallowing, physical effort, etc. It may be that the increased intratracheal pressure serves to stretch the trachea, thereby aiding the elevators of the larynx. While the larynx occupies this elevated position with closed glottic valve, no normal voice is possible. For proper vocalization, the larynx must remain in its natural position, low in the neck for low tones, with the valve-like action of the glottis held entirely in abeyance. This very control of the larynx is what the untrained singer or speaker who has a very bad voice particularly lacks. What occurs when the untrained person takes a breath preparatory to uttering a sound, especially a loud sound? Why, subconsciously the larynx rises in the neck, the glottic valve closes, and no real voice is possible. So difficult is it to teach a beginner to direct his volition so as to control this sub-

conscious action that many varied systems of bodily exercises, and a variety of bodily poses, were prescribed, intended, in my opinion, to create a spirit of effortlessness in the pupil, to dissociate this glottic valve action from bodily effort. All but one of the extrinsic muscles of the larynx are attached to the thyroid cartilage, and the elevators include the thyrohyoid, stylo- and palatopharyngei, and those muscles which pass from the skull downward to find their insertion in the hyoid bone; *e.g.*, stylohyoid, mylohyoid, geniohyoid, digastric. Even the muscles which close the jaws assist in elevation of the larynx. Tension of these muscles holds the voice box in a rigid sling and at the same time compresses it against the spinal column. Vibrations are hampered. The larynx, hyoid bone, soft palate, pharynx together form a mixed system concerned in all bodily functions of the larynx, both extrinsic and intrinsic muscles functioning together a good part of the time. Additional factors are the contour of the cervical spine, its curves, the relative power of the various extrinsic laryngeal muscles, the particular region of the cervical spine with which the larynx has its relation by virtue of the person's anatomical arrangement or because of muscle habits which he has acquired. All these factors are concerned and help to explain how in certain individuals the larynx is clamped too tightly against the spine. A large voice box capable of producing a big tone may yet prove to be more effectively crowded against the spine by the overlapping muscles which pass upward in the front of the neck, with consequent poor vocal powers. The interplay of the muscle groups which are concerned in voice production is not in all of us correctly harmonized for production of the best tones. This fault may exist in one person only for speech, in another only for song. Interference with function of neck muscles in their relation to the voice led Hudson MacEwen to oppose the enucleation of tonsils with their capsules, because of the damage done to the stylopharyngeus muscles. Any injury which cicatrizes the pillars of the fauces can also hamper the voice.

#### ANATOMIC EXPLANATION FOR ACCEPTED AIDS IN VOCALIZATION.

Teachers of vocalization recommend a certain pose, stance, choice of certain vowels for practice, and there is an explanation for all this in the anatomical arrangement of the parts concerned in voice production. When they advise relaxation

of the throat, they really should ask for relaxation of not only the fauces, but also of the constrictors of the pharynx, elevators of the larynx, release of the muscles concerned in the valve-like closure of the glottis (whether it be the true or false cords or both together that are concerned). The recommendation is to vocalize on the vowel "ee" or "oo" with the tongue held low and forward, its tip resting against the lower incisor teeth or upon their cutting edges. Maintaining the chest in a state of partial expansion serves to move the sternum forward, carrying along its attached muscles, thereby lessening their compression of the larynx against the spine. At the same time this movement expands the pharynx, and likewise serves to relax the muscular bands which stretch from the sternum upward to the larynx and across it, to insertions higher up. The omohyoid muscle is also capable of relaxation while the scaleni muscles act to maintain the elevation of the upper ribs.

The beginner should conceive of the voice producing mechanism as though it were a whistle situated low in the neck. He may find it essential to palpate lightly the cricoid cartilage with the fingertip to guard against its rising upward with every attempt at phonation. He can overcome this attempted rise of the voice box better when he is apprised of this false movement by his finger. Otherwise this subconscious elevation of the larynx into the position it assumes for valve closure occurs without his becoming aware of it. Exhalation of the air with the larynx in this position occurs naturally when one hums. Next the pupil must utter his louder tones with the larynx maintained in the same position in the neck. Of course, it will rise as the tones of the scale are ascended. (Contact of the finger with the thyroid cartilage or the cricothyroid membrane will hinder the voice.) Lowering of the chin and simultaneous elevation of the chest (sternum) help to relax the neck muscles. In addition a forward protrusion of the lower jaw carries the tongue attached thereto forward and widens the space between the base of the tongue and the faucial arches, improving the path of the air-column carrying the sound. After having palpated the neck muscles of various persons, and becoming familiar with the degree of mobility which the larynx is capable of in the good neck, the trained hand recognizes at once unnatural tenseness and fixation of the voice box in the neck. Particu-

larly should we remember the attachment of the middle and inferior constrictors of the pharynx to hyoid bone and to thyroid cartilage respectively, and aim to stretch and loosen these by digital methods. When this tenseness is overcome by repeated lifting of the thyroid cartilage away from the cervical spine, almost at once there is recognizable a clearer, more resonant voice; as if a new vocal instrument had been supplied to the individual. The first treatment by this means is followed for a few days by considerable soreness of the neck tissues affected, but later treatments lose their painful sequela. According to the state of the individual's physiologic processes (which may vary from time to time), tenseness in the muscles mentioned will vary, and on certain days an off-color voice may be corrected by this means. Finally, since voice culture is a long and arduous process, the almost immediate improvement which is demonstrable to the pupil by the external agency of manipulation greatly encourages and shortens the process of training.

Does sinus disease affect the voice, and, if so, how? Since the sinuses are no longer regarded as resonators, the presence of sinusitis cannot affect vocal resonance, except it be in an indirect manner. Of course, total or even partial occlusion of the nasal passages will impart to the voice more or less of a nasal twang. However, sinusitis does affect the voice indirectly, by drying of the pharyngeal mucosa, by causing spasm or tension in the neck muscles, as is often the case, or by cervical adenitis, which commonly is associated with sinusitis. In addition, the muscles and fibrous tissues which cover the anterior spinal region, possibly also the articulations between the cervical vertebrae may be affected in chronic or acute sinusitis. It may be assumed these alterations can impair the voice, whereas pathologic changes within the sinus mucosa can have no deleterious effect upon head resonance. General bodily fatigue, whether due to sinusitis or not, will affect muscle tone and function, thus interfering with good tone-production.

When a singer complains that he has temporarily lost the vibrant quality, or normal timbre, of his voice, yet retains control of the pitch of his notes, the laryngeal examination may reveal a normal larynx and the examiner be at a loss to explain the symptom. Recognizing, however, the role

played by the extrinsic muscles, and other tissues of the neck, the puzzle is solved. Massage, diathermy, can be employed to soften or loosen the affected structures of the neck, with speedy correction of the complaint.

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CASSELBERRY PRIZE FUND.

The sum of \$500.00 having accrued from the Casselberry Fund of the American Laryngological Association for encouraging advancement in the art and science of laryngology and rhinology, said sum is now available, in part or as a whole, for a prize award, decoration, or the expense for original investigation or research in the domains mentioned above. Theses or reports of work done must be in the hands of the Secretary, Dr. James A. Babbitt, 1912 Spruce street, Philadelphia, before Feb. 1 of any given year. Any further information desired will be gladly furnished by the Secretary.



**PRIMARY CARCINOMA OF THE EXTERNAL  
AUDITORY CANAL AND MEATUS.  
REVIEW OF THE LITERATURE  
AND REPORT OF A CASE.\*†**

DR. OTTO C. RISCH and DR. JAMES R. LISA, New York.

Malignant disease originating in the external auditory canal and meatus is one of the most uncommon lesions seen in otolaryngological practice. Many of the textbooks do not even mention the condition, although Politzer<sup>1</sup> has accurately described it. Even in the larger clinics it is seldom seen. Robinson<sup>2</sup> states that among 212,000 cases at the Manhattan Eye and Ear Hospital, New York between 1904 and 1924, only 19 cases were seen of carcinoma of the external ear and canal. Story<sup>3</sup> reports that no case was seen in the largest aural hospital in Ireland in 17 years. Fraser<sup>4</sup> says that only three cases of malignancy of the external auditory canal were seen by him in private practice among 646 patients between 1906 to 1929, inclusive. In the Department of Otology, Royal Infirmary, Edinburgh,<sup>5</sup> of 6,605 cases of disease of the external ear and meatus, 13 were malignant. Connal<sup>6</sup> mentions four carcinomas and two sarcomas among 15,000 cases in the General Ear Hospital, of Glasgow. Pritchard<sup>7</sup> stated that he had not seen a dozen cases of epithelioma beginning in the skin of the meatus in over 25 years' practice. McBride<sup>8</sup> had seen only three cases in 20 years at the Edinburgh Infirmary and in private practice. Bezold<sup>9</sup> found only four among 20,000 as cases. Broders<sup>10</sup> reports by far the highest incidence, 14.28 per cent of involvement of the external auditory canal among 63 cases of carcinoma of the ear. The experience of West<sup>11a</sup> likewise is unusual. In two years, seven cases were seen by him in St. Bartholomew's Hospital, London, six at least presenting good evidence of origin in the meatus. Bonner<sup>12a</sup> claimed that they were fairly common and often overlooked. He had seen five or six in a period of a few years.

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The greatest number of cases of malignancy of the external canal and meatus have followed very long-standing otorrhea. A certain small group, however, differs radically from this large majority, in that history of chronic otorrhea is strikingly absent but pain and discomfort bring the patient to consult a physician early in the course. A case admitted to the Otolaryngological Service of City Hospital first drew our attention to this group, and a review of the literature revealed about three dozen more.

#### CASE REPORT.

The patient, a man, age 60 years, was admitted to City Hospital, Aug. 5, 1932. He had suffered from severe pain



Fig. 1. View of the inferior surface of brain showing the large tumor mass in the region of the right temporal lobe. The arrow points to the malignant polyp which presented in the auditory canal. At the edge of the tumor is the cut dura which separated the mass from the brain tissue.

and a bloody purulent discharge from the right ear for six months. For three months he had occasional headaches. On admission, he was semistuporous and cyanotic. The pupils were fixed, unequal and constricted. In the right auditory canal was a hard polypoid mass, which bled easily on touching. Anterior to the ear was a hard swelling, neither adherent to the skin nor causing discoloration and extending to the midzygoma. The right corner of the mouth drooped. The temperature rose rapidly, reaching  $107^{\circ}$  F. at the time of death, nine hours after admission. An autopsy was performed nine hours later.

Only the pertinent facts are abstracted. Growing from the midportion of the anterior wall of the right external canal was a hard, reddish polyp lying just inside the meatus and covered by a thin purulent exudate. It was continuous, with a large densely hard mass lying anterior to the ear and extending two-thirds of the way to the orbit, destroying the posterior half of the zygoma, the lateral half of the greater wing of the sphenoid bone and the lower half of the adjacent cranial vault. It compressed the brain and the dura under

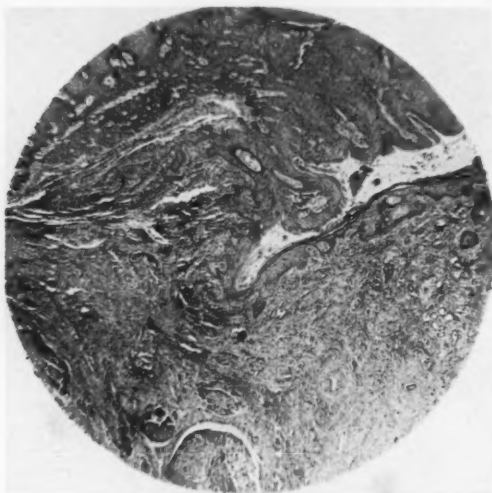


Fig. 2. Low-power microphotograph of the malignant polyp of the external canal. The section is through the polyp, including the base. On one edge can be seen the normal squamous epithelium merging sharply into the carcinoma mass, which has invaded very widely. In the lower part of the picture are seen malignant masses within lymphatic channels.

the bony defect. A small portion of the dura was destroyed, and lying between the brain and the tumor in this region was a small cyst containing clear fluid, probably cerebrospinal fluid. Except for the purulent exudate on the surface of the polyp, pus was entirely absent.

*Histology:* At the base of the polyp was a sharp transition from normal squamous epithelium to the malignant structure, showing marked downgrowth of rete pegs, great irregularity in size of cells and nuclei, wide invasion of the underlying

tissue, loss of polarity and marked pearl formation. The large mass had the same structure. Neither bone, brain nor dura had any malignant invasion. The brain showed a diffuse encephalitic reaction.

*Diagnosis:* Squamous-cell carcinoma originating in the skin of the right external auditory canal.

#### REVIEW OF THE LITERATURE.

*Case 1* (Brunner<sup>13</sup>): Woman age 56 years. Itching of right ear for some years, scratched often with hairpin. Increasing

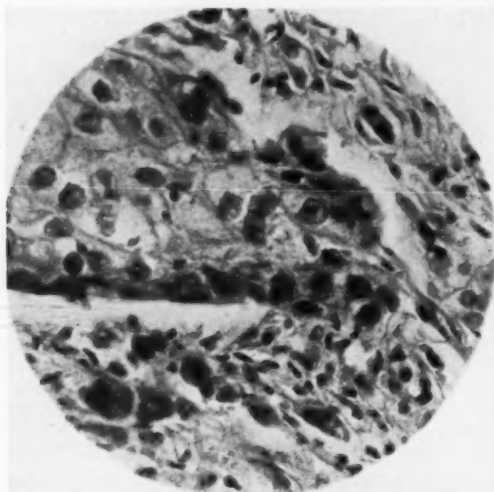


Fig. 3. High-power view of the masses found within lymphatic channels. The structure is typical of the squamous-cell character.

deafness and slight purulent discharge for one year. Then severe pain. Facial paralysis few months later. Canal filled with bleeding friable granulation tissue; no lymph node swelling. Continued pain. Extension to mastoid region and external ear with necrosis and ulceration. Death within year from exhaustion. Histology carcinoma.

*Case 2* (Jacobson<sup>14</sup>): Man age 31 years. Pain and purulent discharge from right ear for six months. Growth for three

months, frequent recurrence after removal. Canal almost filled by granulations arising in anterior and posterior walls. Lymph nodes swollen. Local treatment with arrest of growth. Fifteen months later, purulent discharge, no pain, no increase in tumor. Histology squamous-cell carcinoma.

*Case 3* (Sprague<sup>15</sup>): Woman age 62 years. Fullness in ear, periodic pain and neuralgic headaches for two years. Hard masses from upper and lower walls just inside meatus. Removed one year later. Membrane normal. Death eight months later. Histology adenocarcinoma originating in ceruminous glands of canal or glands near parotid.

*Case 4* (Denker<sup>16</sup>): Wart in canal removed year later; surface left ulcerated. Cured with frequent recurrence during second year. Rapid growth following influenza. Tumor and membranous canal removed four years after onset. Histology adenoma of sudoriferous and sebaceous glands with early malignancy.

*Case 5* (Treitel<sup>17</sup>): Woman age 63 years. Profuse hemorrhage; no otorrhea. Granulation tissue near meatus, tragus thickened. Rapid progress in six weeks with severe pain and facial palsy. Canal filled with granulation tissue. Death three months after onset. Histology epithelioma. Metastases to lungs.

*Case 6* (Trunecek<sup>18</sup>): Man age 45 years. Tumor in canal noted after trauma. In two years, involvement of entire meatus and extension to posterior auricular cleft, then rapid growth with headaches and severe hemorrhages. Under observation seven years later; tumor of canal, destruction of midportion of ear, involvement of mastoid and temporal bone. Local treatment with arsenical preparation. Year later, large defect with local malignant foci. Able to work during entire period of 10 years. Histology scirrhus carcinoma.

*Case 7* (Cheatle<sup>19</sup>): Man age 43 years. Foul discharge for a few months, later pain. Ulcer on floor and anterior wall. Operation refused. Four months later, facial palsy and enlarged glands. Histology epithelioma.

*Case 8* (Bonner<sup>12a</sup>): Woman age 60 years. Deafness three to four years. Discharge one year. Severe pain four months. Meatus swollen and painful on pressure. Incision with free bleeding and no pus. Recurrence of pain in few weeks. Eight

months later, meatus closed; extension to mastoid simulating abscess; no pus on incision. Surgery. Well two and three-fourth years after operation. Histology squamous-cell epithelioma.

*Case 9* (Bonner<sup>12b</sup>): Age 46 years. Pain and discharge from left ear two to three years. Meatus closed, painful on pressure. Postauricular fistula. Histology epithelioma.

*Case 10* (Bonner<sup>12b</sup>): Age 79 years. Discharge from right ear five to six months. Polyp removed later. Meatus closed, ear hard and fixed. Histology carcinoma.

*Case 11* (Tonarelli<sup>20</sup>): Man age 55 years. Tumor of posterior wall of canal and slight discharge for nine years. Gradual increase in growth, pain and discharge. Canal almost closed by bleeding granulations, posterior limit not visible, drum normal. No glands. Histology carcinoma of glands.

*Case 12* (Abbott<sup>21</sup>): Woman age 52 years. Irritating pain in right ear 11 months. No previous discharge. Incision followed by recurrence. Nine months after onset, severe pain, postauricular swelling with fluid and blood on incision. Facial palsy two months later, severe pain and headaches. Histology spheroidal-cell carcinoma thought to be from glands of cartilaginous canal.

*Case 13* (Vaquier<sup>22</sup>): Woman age 51 years. Easily bleeding polyp in canal, bony wall exposed; enlarged preauricular gland, facial palsy. Curettement and chromic acid applications. Two months later, stationary local condition, severe pain.

*Case 14* (Connal<sup>6</sup>): Man age 70 years. Tumor in right ear one year, recurred after removal. Severe pain for few weeks. Growth protruding from meatus, infiltration of wall, sensitive and bleeding. Facial palsy. Middle ear not suppurating. Roentgen-ray with relief of pain. Sepsis and death in two weeks. No autopsy. Histology epithelioma.

*Case 15* (Gibb<sup>23</sup>): Woman age 42 years. Irritation of left ear two to three weeks. Granulation tissue filled canal. Pain and discharge later. Rapid recurrence after removal. Histology epithelioma.

*Case 16* (Walker<sup>24</sup>): Woman age 53 years. Pain in left ear three years. No pus on incision. Glands not enlarged.

Complete extirpation with postoperative X-ray. Histology epithelioma.

*Case 17* (Lake and Bowen<sup>25</sup>): Woman age 28 years. Growth in left meatus curetted. Meatus occluded. Operation and X-ray. Histology carcinoma of ceruminous glands.

*Case 18* (Gruening<sup>26</sup>): Man age 65 years. Discharge 10 months with mass. Very little pain. Mass filling meatus. Surgical removal. Histology epithelioma, glands not involved.

*Case 19* (West<sup>11b</sup>): Man age 45 years. Pain in left ear two years, bleeding recent. Bony meatus involved. Extirpation of bony and cartilaginous meatus and tympanum. Recurrence of discharge two years later with recurrence of growth. Operation, extension of growth to neck of mandible, maxillary region, greater wing of sphenoid, dura and brain. Histology carcinoma.

*Case 20* (West<sup>11c</sup>): Operated with removal of bony and cartilaginous meatus, preauricular and mastoid superficial tissue, lymphatic glands and radical mastoid. Free of disease four years later. Histology squamous-cell carcinoma.

*Case 21* (Yearsley and Butterfield<sup>27</sup>): Woman. Increasing deafness. Meatus occluded by hard mass. Increasing obstruction, slight pain four years later. Surgical removal of tumor from wall at junction of cartilaginous and bony meatus. Well three months later. Histology general resemblance to rodent ulcer but lacking characteristic density and regular staining arrangement, suggesting origin from ceruminous glands.

*Case 22* (Barnes<sup>28</sup>): Woman age 76 years. Irritation of meatus for six weeks. Pain and pus three weeks. Treated for staph. dermatitis. Meatus blocked. Treated three weeks longer, resistant to treatment. Granulation tissue near annulus; removed; dermatitis healed rapidly. Radium 10 days. Well two and one-half years later. Histology epithelioma.

*Case 23* (Fraser<sup>4</sup>): Man age 45 years. Pain five months. Ulcer with red base at junction of bony and cartilaginous meatus. Trichloracetic acid; recurrence; surgical removal; recurrence locally and extension to parotid. Death, no autopsy. Histology epithelioma.

*Case 24* (Fraser<sup>4</sup>): Man age 55 years. Pain in right ear two and one-half years. Granulations in roof of canal; drum



normal. Continued growth. Complete extirpation of bony and cartilaginous canal with radical mastoidectomy. Well five and one-half years later. Histology squamous-cell carcinoma.

*Case 25 (Fraser<sup>4</sup>):* Man age 63 years. Pain and discharge from left ear for several months. Swelling of anterior wall and floor. Sleeve operation; drum normal. Death from pulmonary embolism. Histology epithelioma.

*Case 26 (Fraser<sup>4</sup>):* Woman age 47 years. Pain and discharge for nine months. Bleeding polyp in canal. Parical mastoid and sleeve operation; meatus bony wall and middle ear involved; mastoid antrum, malleolus and incus normal. Histology squamous-cell carcinoma.

*Case 27 (Fraser<sup>4</sup>):* Woman age 62 years. Pain in right ear for 14 years. Tumor in posterior wall. Extirpation of membranous and posterior bony wall; mastoid and drum normal. Recurrence one year and five years afterwards, mass anterior and posterior to ear. Under observation 11 years. Histology first tumor malignant adenoma probably arising from sebaceous glands; five-year recurrence basal-cell carcinoma, rodent ulcer type.

*Case 28 (Dundas-Grant<sup>20</sup>):* Man. Pain. Cutaneous lining of canal swollen, later granulation tissue with exposure of bone. Operative removal. Histology epithelioma.

*Case 29 (Chubb and Ormerud<sup>20</sup>):* Woman age 42 years. Discharge from left ear for one year; bleeding six months; occasional pain. Polyp in meatus. Extirpation of anterior meatal wall, tragus, portion of parotid and lymphatic glands of neck. Recurrence in six months; regression rapid under radium. Death six months later with cerebral signs; no autopsy. Histology epithelioma.

*Case 30 (Mollison<sup>21</sup>):* Woman age 67 years. Prickling sensation and intermittent pain in left ear for one year. Ulcer on floor of canal. Slow healing under radium; new ulcer in six months. Histology rodent ulcer.

*Case 31 (Robinson<sup>2</sup>):* Pain and right-sided stiffness of neck for two months. Infra-auricular lymph node enlargement. Right facial palsy following month. Biopsy of gland two months later. Radium therapy to local lesion and deep X-ray to nodes. No local disease one year after onset. Histology squamous-cell carcinoma.

*Case 32* (Fineberg and Jorstad<sup>32</sup>): Woman age 49 years. Discharge and pain in right ear constant and intractable. Small granulating surface on floor just inside meatus; drum normal. Rapid increase in size. Six months after onset, canal filled with granulations easily bleeding, bone exposed, drum destroyed. Radical mastoidectomy and radium therapy. Facial palsy six months later. Rapid local destruction. Death in three months. Autopsy, local growth invading dura of middle cerebral fossa; necrotic lateral sinus. Histology squamous-cell carcinoma, grade 3.

*Case 33* (Blakewell<sup>33</sup>): Woman age 37 years. Discharge with occasional bleeding on manipulation; progressive increase. Tumor of posterior wall internal to meatus. Removal with free bleeding, drum normal. Recurrence in three weeks. Mastoidectomy. Mastoid normal. Postoperative radium therapy. Histology first biopsy suggestive of epithelioma but not positive; second, basal and prickle-cell carcinoma.

*Case 34* (Land<sup>34</sup>): Woman age 76 years. Severe pain and discharge from right ear for two weeks. Scaly nodule eroding posterior wall of meatus; drum normal. Facial palsy several days later. Sleeve operation, mastoid and facial canal involved. Radium implants. Local recurrence, treated. Recurrence in one and one-half years and again eight months later. Extirpation. Well three and one-half years after first operation. Histology squamous-cell carcinoma.

*Case 35* (Lukens<sup>35</sup>): Pain, discharge and growth in canal. Removal and recurrence; removed four months later and radioionization used. Well seven years later with no recurrence. Histology adenocarcinoma.

A few other cases are mentioned in the literature but the data on each are scanty. Urban Pritchard<sup>7</sup> had two cases on which he operated. One lived seven years without recurrence and died of unrelated causes. The other patient was known to be well four years later. West mentions four other cases in his practice in addition to those quoted in detail. Dundas-Grant<sup>29c</sup> said he had seen several similar cases and, in his own report, quoted an additional one. McBride<sup>8</sup> also mentions one case. A small, painful point in the ear with continuous pain made him suspect malignancy, which was confirmed by biopsy. He removed the area freely with an enlarged mastoid gland. Phillips<sup>36</sup> quotes a case he presented before the New York

Otological Society of epithelioma arising in the floor of the canal, which had been considered a mastoid case at first.

Harris' case<sup>37</sup> had several features similar to some of the cases of this series. The histology, however, was not conclusive and some observers suggested the possibility of sarcoma. His case is very similar to that of Busacca,<sup>38</sup> in which sarcoma was proven by biopsy.

#### DISCUSSION.

The separation of primary carcinomas of the external auditory canal into two groups, one secondary to and one arising in the absence of preceding chronic otorrhea, seems to have almost completely escaped mention in American literature, although many of the foreign observers draw a sharp distinction. Treitel was the first to suggest it. Connal, McBride, West, Bonner, Dundas-Grant and Barnes, all stress this differentiation. Several mention specifically the complete absence of suppuration of the middle ear.

Severe pain is an outstanding and early symptom, frequently associated with a discharge which may be foul or bloody. The presence of granulation tissue showing a tendency to friability and easily bleeding on manipulation is usually present. Dundas-Grant states that the characteristic feature of the early stage is "the intense pain quite out of proportion to the amount of change in the ear. The ear condition looks like simple granulation tissue." Barnes also states that irritation and pain are early. Bonner says that the symptoms at first are very like furunculosis of the external meatus. Barnes also stresses this point. He says, "in a case of unilateral dermatitis which does not yield to the usual lines of treatment—especially if any tissue resembling granulation tissue can be seen, or if there is unusually free bleeding—an attempt should be made to obtain tissue for section." The pain is attributed by Barnes to infection of the growth and skin of the meatus. A review of the literature supports them in their stand. Pain and pus were present in two-thirds of the cases.

The presence of tumor as a presenting symptom was present in a small number. Usually this group had carcinoma originating in the glands and were not epitheliomas. Frequently, the tumor was discovered because the patient noticed a unilateral sensation of fullness in the ear or gradually developing

deafness. Pain was comparatively late in its appearance; ordinarily it began more as a feeling of irritation before progressing to frank pain. Discharge varied but was frequently absent.

The development of facial paralysis is a further aid in differentiation between the two groups. In the cases following chronic otorrhea, pain and facial paralysis occur almost simultaneously, although the paralysis may be partial for many weeks (Barnes). In the other group, paralysis is much less frequent and usually much later in its appearance. It was noted in 10 of the 36 cases and not mentioned in the cases with scanty data. It developed in the majority of instances from six months to four years after pain appeared. Three times it was very early—six weeks, three months, two weeks. In the cases with very rapid development, the malignancy was of a high grade, spread rapidly or recurred quickly. One apparently was cured.

The site of origin in the two groups is also different. In the cases following chronic otorrhea, the origin is either in the tympanic cavity, mastoid cells or in the floor of the deepest portion of the meatus. In the group under consideration, most of them were situated anteriorly and not infrequently were noted as just inside the meatal opening. There were but few noted as originating in the deep portion of the canal or at the junction of osseous and membranous portions.

The type of carcinoma is most frequently epithelioma, 23 of the 36 cases being so diagnosed. Three were called simply carcinoma. Eight were of gland type. Basal-cell tumors were uncommon, one showing both basal and squamous elements.

The cancerous process, according to West, tends to extend anteriorly, to the mastoid and to the middle ear. The course in many cases confirms his observations. The disease tends to extend locally into the adjacent structures, the direction modified by the site of the primary lesion.

Metastases are infrequent and seem to have a predilection first for the preauricular glands and then for the upper deep cervical chain. Many observers noted that the glands were not enlarged. Histological examination of enlarged glands was not recorded in many cases and the enlargement may possibly have been inflammatory and not neoplastic. In the

few cases examined histologically, they were found not involved by neoplasia.

Sex has apparently but slight relationship to the development of malignancy in the auditory canal, although women slightly outnumber men in the series. The ages ranged from 28 to 79 years, the largest number occurring in the fifth, sixth and seventh decades.

Predisposing conditions seem curiously absent, only one case (Brunner) having a history of an itching lesion for several years, which had been continuously irritated by trauma with a hairpin.

The prognosis, even when the cancer is of the epithelioma type, is usually favorable, if the condition is diagnosed early and proper therapy is instituted. Many of the cases have had a long course and several have been free of disease for two or more years after the primary focus was removed. Some have been well for four years or longer. The epitheliomas which develop facial paralysis soon after the onset of pain have a poorer prognosis and tend to have rapid local recurrence and extension. The tumors originating in the glands have a better prognosis than the epitheliomas. The basal-cell types are too scanty to judge but it is noteworthy that one case treated by conservative methods recurred; the one operated and treated with radium was free of disease 15 months later. As Bonner<sup>12a</sup> stated, it is of "great importance that they should be recognized . . . as early as possible."

Surgery appears to have given the most satisfactory results. The posterior auricular approach is recommended by most of the operators, and removal of the membranous and osseous canal and preauricular glands. The posterior approach affords an opportunity to judge the extent of involvement of the superficial mastoid tissue, the mastoid, tympanic cavity and the anterior extension, which serve as guides for the extent of operative procedures necessary in each case.

A few cures have been reported following radium therapy. In some instances there were recurrences.

#### SUMMARY AND CONCLUSIONS.

A review of the literature on primary carcinoma of the external canal and meatus arising in the absence of chronic

otorrhea is presented and an additional case reported. The presenting symptoms in the majority of cases are severe pain and discharge; a smaller number present as masses causing discomfort. Most of the cases are epitheliomas. Carcinomas arising from glands are less frequent but not unusual. Basal-cell types appear with least frequency. Facial paralysis develops later or not at all. The prognosis is usually good, if the diagnosis is made early. The value of biopsy in questionable cases is stressed. Surgical procedures with complete extirpation have given the most favorable results.

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**TETANUS ASSOCIATED WITH ACUTE OTITIS MEDIA;  
PROBABLE ATRIUM TETANUS. REPORT OF  
TWO CASES.\***

DR. PHILIP S. STOUT, Philadelphia.

Reporting two cases of tetanus occurring about the same time; coming to St. Luke's and Children's Hospital, Philadelphia, from northeastern Philadelphia. Both cases were boys under 12 years of age; one recovered, the other died about six hours after entering the hospital. Both were given the same amount of antitoxin. Both had acute otitis media a short time before the onset of the symptoms of tetanus. Neither of them had any scar, inflammation or history of any injury that might have caused this infection, except the acute otitis media. In one case, D. L., we were able to get a history of the enlarging of a cesspool in the yard of his home and that he played around the working men. He developed acute otitis media at this time.

In the other case, A. P., we learned through the family physician that he frequently played on two vacant lots near his home.

The histories are as follows: A. P., age 8 years (Case 14,362); St. Luke's and Children's Hospital, Philadelphia; service of Dr. C. Fischer, referred by Dr. Huttenlock; Dr. K. Lau, Interne. Admitted March 19, 1938, 1:30 P.M.; died March 19, 1938, 7:55 P.M. (Accompanying photograph made two hours after patient entered the hospital.)

*Chief Complaint:* Child came in with stiffness over entire body; opisthotonos; high fever.

*Family History:* Essentially negative.

*Personal History:* Normal, full-time baby; measles, age 2 years; no other illnesses; no injury or operation.

*History of Present Illness:* Patient had a running ear for two or three days last week. All discharge ceased one week

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\*Presented at the Staff Meeting of St. Luke's and Children's Hospital, Philadelphia, April 26, 1938.

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ago. Patient seemed perfectly well until two days ago (March 17, 1938), at which time he complained of stiffness of the neck. He was treated locally at home by parent. Next day, he complained that the neck was worse; had difficulty in walking. Family physician was called and prescribed. The night before the patient came to the hospital he had pain in the umbilical region of abdomen, stiffness and discomfort in left leg and some inability to move jaws. This morning was seen by physician in state of opisthotonos and brought into the Accident Ward and admitted to the hospital. No history of injury of any nature; no apparent marks of any external violence. (Note—He frequently played on some vacant lots near his home.)



Fig. 1. A. P., age 8 years. Tetanus. Notice characteristic pose, extreme opisthotonos, rigidity and position of hands and legs; mouth slightly open.

*Circulatory System:* Tachycardia. No fibrillation. Muscle tone fair. No audible murmurs. No cardiac enlargement. *Respiratory System:* Dyspneic. No rales. Percussion note resonant. *Urinary System:* Negative. *Nervous System:* Definite ankle clonus; exaggerated knee-jerks; unable to elicit Kernig or Brudzinski; Babinski also negative. No photophobia. *Summary:* Tetanus (Dr. Lau). Dr. Carl Fischer: "History and physical findings suggest probable tetanus, especially in view of marked trismus, opisthotonos and clear spinal fluid."

*Second examination* made same day by another physician. Young white male, age 8 years, with history of running ear a week and a half ago, which ceased discharging after two or three days. Two days ago, had stiffness of legs, jaws and entire body. The patient is flushed, feverish; rigid, opisthotonos; stiffness of jaw, neck, abdomen, limbs. Positive ankle

clonus. Exaggerated knee-jerks. Stiffness interferes with other reflexes. Jaw can be opened about one-half inch; tongue slightly protruding position. Head twisted to one side and resisted effort to change position (probably spinal accessory involvement). No photophobia. No vomiting. No headache. Mentality clear, alert and co-operative. Abdomen rigid (no reflexes obtained) (Dr. Bresler).

*Neurologic* (Resumé, Dr. Gilpin): Examination shows extreme opisthotonos; stiffness in hypertension on stimulation. No history of wound of entry. Examination shows evidence in favor of tetanus. Tetanus antitoxin indicated; prognosis poor. Treatment: Tetanus antitoxin; sedation; darkened room; isolation. Fifty thousand units of tetanus antitoxin were given; 40,000 intravenously, 10,000 intramuscularly.

*Ear, Nose and Throat Examination* made immediately after admission (Dr. P. S. Stout): Right Ear: Drumhead, no evidence of perforation at present, no pressure in canal, slight amount of wax (may have been dried blood). Left Ear: Drumhead slightly congested, probably from previous examination; wax (or debris) in external canal removed. His hearing seemed about normal. Mastoids: Negative. Mouth: Teeth and tonsils, unable to examine because he was unable to open his mouth (is able to answer questions but talks slowly). Nostils: Dry; negative. Eyes: Nystagmus to the right; slow.

*Laboratory Findings* (Dr. Barthmeir): Spinal Fluid: 10 cc., clear; normal pressure. Cell count, two lymphocytes. Sugar present. Globulin absent. No organism found in smear. Wassermann and Kahn: Spinal fluid, negative. C.B.C.: Hemoglobin, 77 per cent; red count, 4,230,000; color index, nine; white count, 20,400; polymorphonuclears, 80; lymphocytes, 20.

Temperature on admission was 103.4°, which rose to 107° just before death. Pulse, 160 on admission, went up to 180 before death. Respirations, 58-60.

*Complete autopsy* day after death. Thymus not enlarged and negative findings, except blood in left ear canal, clotted blood in right middle ear and antrum (several tablespoonfuls of blood ran from left ear just before death). Brain dry, mottled, no adhesions, no evidence of abscess. Sphenoids, ethmoids and antra negative. Other findings negative.

This patient came into the hospital on a Saturday afternoon and died about six hours later, so we did not get a positive culture of tetanus from the ears or from any other laboratory findings; however, the dozen or more physicians who saw him agreed to a man that it was tetanus.

*Case 2:* D. L., age 11 years, male, white, American (Case 14,477); admitted March 28, 1938, St. Luke's and Children's Hospital, Philadelphia; service of Dr. C. B. Saul. Discharged April 4, 1938; improved.

*Chief Complaint:* Inability to open mouth; discharging right ear.

*Family History:* Father and mother living and well; two brothers living and well. One brother had two mastoid operations, one in 1936 and one in 1937; father had a mastoid operation in 1936. No history of cancer, diabetes, tuberculosis, kidney or heart disease in family.

*Personal History:* Normal delivery, seven pounds; measles, chickenpox; present weight is 65 pounds, is short and looks underweight; is a small eater. Tonsillectomy, age 7 years. Fifth grade in school, quite active mentally and physically.

*History of Present Illness:* Wednesday night, five days before admission to the hospital, the patient complained of earache, which subsided. Three days later, he ran a temperature of  $104^{\circ}$  to  $105^{\circ}$ . This subsided next day after application of heat by mother. The drumhead ruptured and he appeared better. Temperature taken by mother; ranged from normal to  $101^{\circ}$ . Two days later, the stiffness of the face and jaws became acute; he was very irritable and wanted to sleep, but could not. Swelling on right side of face over parotid. Says he has pain like a toothache and is unable to open mouth.

*Examination on Admission to Hospital:* White, male child, lying in bed, irritable, disturbed by light and movement. Talks between his teeth, is unable to open mouth. Head bent forward. Abdomen: Scaphoid; good muscular tone; no tenderness or rigidity; no masses. Heart: Negative. Respiratory system: Negative. Reflexes: Hyperactive. Eyes: Negative. Ears (Dr. P. S. Stout): Right Ear: Whitish, purulent discharge; large perforation of drumhead; no drooping of pos-

terior or superior wall of external canal; no tenderness or swelling over right mastoid. Later blood oozed from right ear, followed by seropurulent discharge. Swelling of parotid gland on right side. Left Ear: Negative.

*Laboratory Findings* (Dr. Barthmeir): March 28, 1938: Spinal Fluid Findings: Five cc. clear cerebrospinal fluid removed under 2+ pressure; cell count, two lymphocytes; sugar, present; globulin, negative; culture, negative.

March 28, 1938: White count, 23,800; polymorphonuclears, 83 per cent; lymphocytes, 14 per cent; monocytes, 2 per cent; eosinophils, 1 per cent; basophils, none.

March 29, 1938: Hemoglobin, 74 per cent; R.B.C., 4,040,000; color index, 0.9; W.B.C., 25,400; polymorphonuclears, 90 per cent; lymphocytes, 10 per cent.

March 29, 1938: W.B.C., 23,800; polymorphonuclears, 83 per cent; lymphocytes, 14 per cent; eosinophils, 1 per cent; monocytes, 2 per cent; basophils, none.

March 30, 1938: Hemoglobin, 80 per cent; red count, 3,850,000; color index, one; white count, 18,000; polymorphonuclears, 76 per cent; lymphocytes, 24 per cent.

April 2, 1938: Hemoglobin, 72 per cent; red cells, 3,960,000; color index, 0.9; leukocytes, 22,000; polymorphonuclears, 88 per cent; lymphocytes, 12 per cent.

While in the hospital, his temperature ranged from 100° to 103.5° on the day of admission, continued to have temperature for five days, dropping a little each day and becoming normal on the fifth day, then a slight rise each day for several weeks.

The patient left the hospital on the eighth day. The ear became dry a few days later.

About three weeks from the onset, two weeks after he left the hospital, the jaws again stiffened up a little but this lasted for only a few hours. The pain in the right ear came on again with some discharge; slight temperature for a few days. No additional serum was given for this second attack. He had already had 50,000 units on admission to the hospital and this second attack lasted only a few hours. After this

second attack, he had a slight rise in temperature each day for four or five days, when his temperature dropped to normal and remained there. His pulse went up to 120 while he was in the hospital but dropped with the subsidence of the fever to near normal. Respiration went up to 32 on day of admission to the hospital but gradually dropped to near normal.

He had distinct swelling of the right parotid gland and pain over the side of the face and down his neck. The stiffness of the jaws, however, was the same on both sides. He lay with his head bent forward, *emprostotonos*, which lasted for several days. He seemed unable to straighten up.

Treatment: Fifty thousand units of tetanus antitoxin given at once; 40,000 units intravenously, 10,000 units intramuscularly.

In conclusion, here were two youngsters, perfectly healthy until something happened to their ears. Only one ear was affected in each case. Both complained of earache as a first symptom. This seemed to get better, when suddenly they showed signs of high fever, irritability, stiffness of jaws, inability to eat, with profound *opisthotonos* in one case and *emprostotonos* in the other, combined with high fever, high leukocyte count — up to 23,000, with polymorphonuclears up to 90 per cent — rapid pulse and rapid breathing. Blood oozed from the ear in both cases; in one case just before death, in the other case on the day he came to the hospital. We were not able to recover the tetanus germ in either case.

These cases were presented before the St. Luke's and Children's Hospital Staff Meeting on April 20, 1938.

The following physicians saw either one or both of these patients and were agreed on the diagnosis of tetanus in the case of A. P., and fairly well agreed on the diagnosis of tetanus in the case of D. L.: Dr. C. D. Saul, Dr. C. C. Fischer, Dr. S. Gilpin, Dr. Huttenlock, Dr. Hancock, Dr. Axelrod, Dr. H. Agerty, Dr. O. F. Barthmeir, Dr. R. Juele, Dr. Norwick, Dr. Bresler, Dr. Pearse, Dr. J. Wessels, Dr. L. J. Redman, Dr. N. Karakashian, Dr. Lau and Dr. P. S. Stout.

#### COMMENTS.

Here were two cases of probable tetanus with the middle ear as the place of growth of the tetanus germ, spoken of as

atrium tetanus; both cases were young children. Our treatment was the same in both cases; one lived, and the other died. The ease with which these two healthy children seemed to contract this disease makes us wonder if there are not more cases than are reported. Tetanus toxin is so extremely virulent.

We think that in the future possibly 100,000 units of tetanus antitoxin should be given as an initial dose and repeated if the symptoms warrant it.

I desire to express my sincere appreciation in being permitted to co-operate in these two unusual cases.

269 South 19th Street.



**PETROSITIS, MENINGITIS (STREPTOCOCCUS BETA);  
SULFANILAMIDE, DRAINAGE, RECOVERY;  
REPORT OF CASE.\***

**DR. C. C. ROE JACKSON, Cleveland.**

Already, the number of cases of hemolytic streptococcal meningitis responding favorably to the therapeutic effect of sulfanilamide or its compounds and assisting factors is increasing daily. No attempt is herein made to review the literature, to group the cases collectively according to the mode of entry, or to embark upon any lengthy discussion. Suffice it to say, that there arises in each case, no matter how closely it may resemble some other reported one, an entirely different picture; and, again, we realize that every case is a law unto itself. Everyone is cognizant of the fact that the features bearing on this variability are involved with anatomical background and influenced by developmental and intercurrent phenomena, such as infection and immunity.

This case is reported because of its intrinsic value, especially since it presented at least two courses in the line of treatment. Recovery naturally leads one to believe that the procedure taken was the best, and yet another course might have been equally successful if similar facilities had not been available.

Report of Case: E. F., white girl, age  $6\frac{1}{2}$  years, who, at the age of 4 years, had had an attack of measles, complicated by an acute suppurative right otitis media, came to the Pediatric Dispensary of the University Hospitals on Jan. 4, 1938, with an acute cold and another attack of acute right otitis media. On Jan. 25, she was referred to the Otolaryngological Service. Her temperature was  $39.2^{\circ}$  C. and she had the clinical picture of a right acute suppurative mastoiditis, which later was confirmed by Roentgen ray examination, revealing a coalescent mastoiditis. She was next seen in the dispensary on Feb. 3, 1938. At this time she was admitted to the hospital, and a right simple mastoidectomy was performed.

On the fourth, fifth and sixth postoperative days her temperature reached  $38^{\circ}$ ,  $38.8^{\circ}$  and  $37.5^{\circ}$  C., respectively. She was discharged on Feb. 10, 1938. Three days later, the postauricular wound ceased draining and two days later she had mild right otalgia with slight fever. On

\*From the Department of Surgery of the University Hospitals and the Western Reserve University School of Medicine.

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TABLE I.

	Hgb. %	W.B.C.	R.B.C.	Sulfanila- mide Dose —Gm.	Blood Sulfanila- mide Level	Spinal Fluid Sulfanila- mide	Spinal Fluid Cell Count	
Feb. 16	80	30,000	4.1				6,000	Onset meningitis
Feb. 20			4.2	3	6.8	5.8		
Feb. 21	74		3.7	3	8.1	7.1	700	
Feb. 22	66	A.M. 7,800 P.M. 11,600						
Feb. 23	61	7,300	3.8	1.5	6.3	4.2		
Feb. 24	65	12,450	4.07	2.5			240	Operation
Feb. 25	68	25,000	4.11					
Feb. 26	62	20,000	5.14	0.5				
Feb. 27				Stopped				
Feb. 28	56	15,900	4.21					Plaster cast, right leg and foot
Mar. 4		18,500						
Mar. 7								
Mar. 29	65	6,200						Drainage tube removed
Apr. 11		4,950						Plastic repair
Apr. 29								

Feb. 16, the patient vomited frequently throughout the day, and she was admitted to Babies and Childrens Hospital. The right tympanic membrane was slightly hyperemic and full, and some granulations were present in the postauricular wound. Weakness of the right external rectus muscle was noted, but the temperature reached normal.

The next day there was no vomiting and no fever, and the drain was removed from the postauricular wound. Two days later, on Feb. 19, 1938, at 7 P.M., she complained of right frontal headache and she vomited. At 9 P.M., her temperature was  $40^{\circ}$  C. and the reflexes were increased. A paracentesis of the right tympanic membrane released only serum. The next day the neck was rigid and a positive Kernig sign was present. The spinal fluid had 6,000 cells per cmm. and beta streptococci were cultured from it. The patient was put on a Bradford frame and a continuous intravenous drip of 2.5 per cent glucose with spinal drainage every two hours was given. The next day sulfanilamide was started. The accompanying table gives a detailed record of the blood picture, sulfanilamide level, spinal fluid findings, etc.

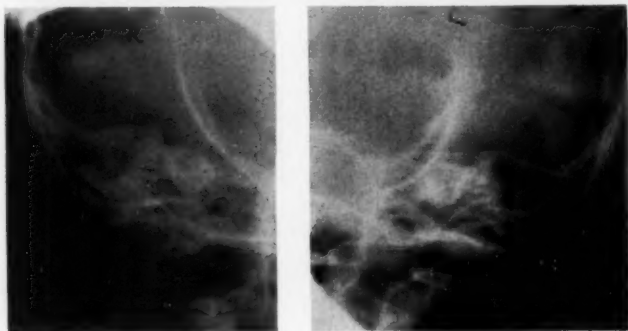


Fig. 1. Right temporal bone (Stenver's position) showing discontinuity of the superior margin medial to the anterior semicircular canal as compared to the left.

On Feb. 23, 1938, Roentgenograms of the petrous portion of the right temporal bone showed loss of bony outline medial to the anterior semicircular canal (see Fig. 1), at least insofar as the superior aspect was concerned. It was then thought fair to assume that the apex of the pyramid was replaced by an abscess cavity which had ruptured into the subdural space and was draining by the spinal route. The cell count of the spinal fluid was decreasing and the meningitis improving under the sulfanilamide therapy. The question arose as to whether or not there was pus present in the abscess cavity and whether or not there was sufficient drainage. No one cared to assume the responsibility of saying there was no pus present and that adequate drainage existed. Consequently, it was decided to explore the apex of the pyramid.

On Feb. 24, 1938, the postauricular wound was reopened and the previous operative cavity cleaned of granulation tissue. The internal plate of the pyramid was followed medialward on the posterior and superior aspects. The three semicircular canals were exposed carefully and there was no gross evidence of a fistula tract, but it was rather easy to establish one through the arch of the anterior semicircular canal. As soon as this was done, a cavity was entered and cloudy serum escaped; a

culture of this failed to produce any growth after four days. This small outlet of drainage externally from the abscess cavity was not thought sufficient, so the cephalic internal plate (tegmen) was removed to the anterior semicircular canal and upon going over it the same cavity was entered as via the opening in the arch. A rubber dam drain was placed into the cavity over the anterior semicircular canal and the wound left open. Fig. 2 is the follow-up Roentgenogram.

Improvement continued and on March 1, 1938, there was noticed a flaccid palsy in the distribution of the right peroneal nerve, probably

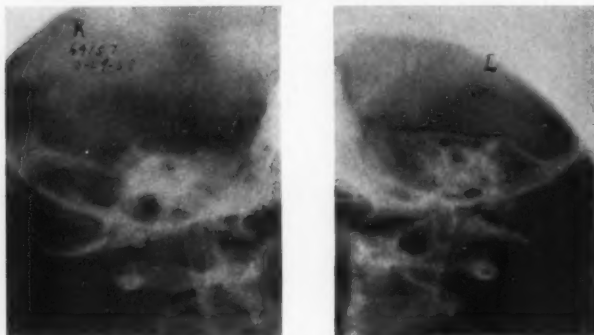


Fig. 2. Postoperative view of the right pyramid showing the lack of the entire superior plate and a few small particles of lipiodol injected into the cavity at the time of operation. Compare with the left side.

due to the four-day period on the Bradford frame. Orthopedic and physiotherapy measures were instituted for this complication.

On April 11, 1938, the drain was removed from the abscess cavity, and on April 29 a plastic repair was done on the postauricular wound. There was returning function of the peroneal nerve. On May 10, 1938, the day of discharge, hearing test on the audiometer revealed normal hearing acuity in the right ear, and examination showed a completely healed operative wound with a normal eardrum.

Western Reserve University.

## MYXOFIBROMA OF THE LARYNX. REPORT OF TWO CASES.\*

DR. SAMUEL WEINSTEIN, Brooklyn.

Myxofibroma of the larynx occurs rarely enough to be reportable. Of the two cases reported in this paper, one is a private case of my own, and the other is from the service of Dr. Philip Leibowitz, Attending Otolaryngologist, Jewish Hospital, Brooklyn.

There is not much available data upon this type of laryngeal tumor. After the diagnosis was established microscopically, in my case, I wrote to the Jacksons for any information that they might be able to refer me to, and they replied as follows:<sup>1</sup> "The matters referred to in your letter are given in the book, 'The Larynx and Its Diseases,' so far as such information is available.

"We might add, however, that our opinion is that you should certainly report your case of myxofibroma."

Dr. James Ewing<sup>2</sup> wrote me as follows: "I do not remember seeing a myxofibroma of the larynx, and I find no reference to this condition in my records. I think Dr. Jackson's cases are among the few recorded."

In reviewing all the cases of laryngeal neoplasm admitted to the Jewish Hospital, of Brooklyn, from the beginning of the year 1928 to the end of June, 1938, I found another case of myxofibroma in addition to my own. I have made a numerical summary of these cases according to the clinicopathological diagnoses. In all, there were 85 cases, and they were distributed as follows:

Diagnosis	Number of Cases
Polyp of vocal cord	24
Papilloma of vocal cord	13
Fibroma of vocal cord	4
Vocal cord nodule (removed)	1
Angiomatous papilloma	2
Angiomatous polyp of vocal cord	1

\*From the Department of Otolaryngology, Jewish Hospital, Brooklyn.

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Diagnosis	Number of Cases
Fibromatous papilloma	2
Angioendotheliomatous polyp	1
Hemangiofibroma of vocal cord	1
Hemangioma of vocal cord	4
Myxofibroma of vocal cord	2
Hyperkeratosis	3
Prolapse of left ventricle	1
Massive papilloma of larynx requiring laryngofissure	1
Squamous-cell carcinoma of larynx	17
Basal-cell papillary carcinoma	1
Papillary carcinoma	2
Carcinoma of pyriform sinus	2
Carcinoma of thyroid secondarily involving larynx	2
Generalized kaposi sarcoma involving larynx	1



Fig. 1. Photomicrograph of section of myxofibroma, Case 1.

#### REPORT OF CASES.

Case 1: No. 210,978, J. L., white, male, age 35 years, married, policeman. Diagnosis: Myxofibroma of larynx. Chronic laryngitis.

This patient first came under my care in March, 1932, at which time he had an acute tonsillopharyngolaryngitis. He was treated accordingly and, because of recurring attacks subsequently, he was tonsillectomized on Oct. 22, 1935. He returned for a follow-up examination on Oct. 29, 1935, and then I did not see him again until April 13, 1938.

At this time he complained that he had suddenly lost his voice for several hours the day before, and that, although he recovered it subsequently, he was still very hoarse. Indirect laryngoscopy revealed that the larynx was chronically congested, the false and true cords thickened, and there was interarytenoid hyperplasia. On the right vocal cord, at the anterior commissure, there was a pale, edematous looking growth, the size of a pea.

Hospitalization for removal of the growth by means of direct laryngoscopy was advised. This was done the following day. The patient was seen several times subsequently, the last time being June 17, 1938. The cords at this time were somewhat thickened and injected, otherwise negative. The patient is not hoarse, although there is a little thickness to his voice, due to the chronic laryngitis.

Pathology Report: S.P. No. 38-1,156. Unit No. 210,978.

Description: Gross: The specimen consists of several portions of gray, opaque tissue, up to 0.6 x 0.4 x 0.1 cm., said to have been removed from the right vocal cord. One surface is smooth and glistening, the other is rough. The entire specimen is taken for microscopic study.

Microscopic: The circumference is covered by stratified squamous epithelium with keratinizing superficial and spinous layers and blunt rete pegs. The subjacent tissue is loose, in places myxomatous, with distended blood vessels and slightly infiltrated with extravasated blood, small and large mononuclear cells and occasional polymorphonuclear leukocytes.

Diagnosis: Myxofibroma of vocal cord, right.

Case 2: No. 125,225, W. B., white, male, age 28 years, artist. Diagnosis: Fibromyxomatous polyp of larynx.

This patient was admitted to the otolaryngological service of Dr. Philip Leibowitz on Dec. 19, 1929. For two years previous to his admission he had noticed that his voice had become progressively more hoarse, and for two weeks prior to his admission he had been coughing.

A direct laryngoscopy was performed on the day of his admission and a small growth removed from his right vocal cord. He was discharged the next day and was not seen any more.

Pathology Report: Slide No. 22,571. Acc. No. 144,077.

Macroscopic: Specimen consists of a minute piece of gray tissue.

Microscopic: Examination shows tissue to be made up of a lining of stratified epithelial cells, surrounding an area of loose areolar and fibromyxomatous structure and newly formed blood vessels.

Diagnosis: Fibromyxomatous polyp.

#### COMMENT.

James Ewing,<sup>2a</sup> in a general discussion of myxoma, says that myxoma is a tumor composed of mucous tissue, and that primary myxoma, a tumor which probably arises from embryonal mucous tissue, is rare; but mesoblastic tumors, such as fibroma, lipoma and chondroma, which contain myxomatous tissue, are not infrequent. It is often difficult to determine whether the myxomatous portion of a complex tumor is originally of this type or represents a degeneration of the more adult tissue.

He also says<sup>3b</sup> that the clinical course of myxoma is of a slowly growing tumor, which produces no symptoms except local swelling and pressure. After complete extirpation they



do not recur, but thorough removal is not always readily accomplished and local recurrence of this benign tumor is not uncommon. As a rule, malignant myxomas fall readily in the class of myxosarcoma.

Simple myxoma rarely attains a large size, and the onset of myxomatous changes usually marks a partial limitation of the growth capacities of a tumor.

The Jacksons<sup>4</sup> say pure myxoma is not common in the larynx; more often it occurs as a form of cell degeneration in fibromatous or other tumors. They have seen two cases of apparently pure myxoma and three cases of fibromyxoma. None recurred after removal by direct laryngoscopy. If there should be any indication of sarcomatous development, treatment would take the form of operation for malignant disease of the larynx.

Sir St. Clair Thomson,<sup>5</sup> in discussing tumors of the larynx, says that myxoma is such a rare form of laryngeal tumor that Morrell MacKenzie only recalls one instance. In several cases at first thought to be of this character, a closer investigation proved the growths to be fibromata undergoing myxomatous degeneration. The tumor may be small, not much larger than a pin head, or it may reach the size of a pea. It may be sessile or pedunculated, has a jelly- or cyst-like appearance and, as a rule, is implanted on the edge or surface of the vocal cord.

#### SUMMARY.

Two cases of myxofibroma of the larynx, because of their rarity, are reported for recordal purposes.

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JOINT MEETING OF  
**THE NEW YORK ACADEMY OF MEDICINE**

SECTION ON OTO-LARYNGOLOGY.

AND

**THE COLLEGE OF PHYSICIANS OF PHILADELPHIA.**

SECTION ON OTO-LARYNGOLOGY.

*Held at the New York Academy of Medicine, March 16, 1938.*

*(Continued from August issue.)*

**Treatment of Laryngeal Carcinoma. Dr. Rudolph Kramer.**

*(Published in full in this issue of THE LARYNGOSCOPE.)*

DISCUSSION.

DR. GABRIEL TUCKER: I have had the privilege of going over Dr. Kramer's paper and I wish to congratulate him on his presentation and the results that he has obtained in his series of cases. With the consent of Dr. Kramer, I would like to mention the results in my own series of cancer of the larynx by way of emphasis of the points that he has already made. My series, however, does not include irradiation treatment because I have no statistics available for treatment by irradiation alone. In a consecutive series of 315 cases seen in my private practice and at the Bronchoscopic Clinics at the Hospital of the University of Pennsylvania and Graduate Hospital in Philadelphia, there were 154 cases that we selected as being suitable for surgery. 161 cases from the series were not considered suitable for surgical treatment. This was largely because the condition had advanced so far that there was extensive metastasis or evidence of disease extending beyond the larynx when the patient was first examined.

Surgical Treatment of Cancer of the Larynx: The factors to be considered in the surgical treatment of cancer of the larynx are, first, the location and extent of the lesion, and second, the classification of the tumor on histologic examination of biopsy specimen. The most important consideration is the location and extent of the lesion. The usual classification of tumor of intrinsic and extrinsic was followed. Cancer involving the true cords, posterior commissure, subglottic larynx, was classified as intrinsic and was suitable for surgical cure. The area included in the anterior two-thirds of the true cords, the anterior commissure and the immediate subglottic larynx was classified as anterior intrinsic. In this location the procedure of laryngofissure was the operation of choice in limited lesions. In the posterior portion of the intrinsic area the operative procedure was total laryngectomy. In extrinsic lesions of the larynx involving the ventricular bands, the base of the epiglottis, the area of larynx above the true cords surrounded by the aryepiglottic folds and the posterior surface of the arytenoids were treated by total laryngectomy. In view of the intrinsic cases where either the patient refused a total laryngectomy or for the reason that the patient's general condition would not justify the procedure of total laryngectomy, a partial laryngectomy with intralaryngeal application of radium combined with external irradiation was used. Of the 154 cases, several cases refused surgical treatment and are not included in this summary. In the series there were 92 patients upon whom thyrotomy and laryngofissure was performed. Following laryngofissure there were 11 recurrences and 81 patients who have had no recurrences to date.

The end results are as follows: One case, 15 years, cured; two cases, 14 years; two cases, 13 years; two cases, 11 years; 5 cases, 10 years; eight cases, nine years; 14 cases, eight years; one case, seven years; eight cases, six years; five cases, five years; seven cases, four years; after the four-year period there have been no recurrences; six cases, three years; 11 cases, two years; one case, one year. Cases operated on during the past year without recurrence, eight. Total laryngofissures without recurrences, 81. The vocal results after laryngofissure are excellent. The patient, of course, has a whispered voice immediately and usually there is a good reformation of the cord that has been excised within the first six months following the operation. In the group of laryngofissure cases there were two cases of sarcoma of the anterior end of the cord. The larynges of these patients are free from recurrences, one after three years and the other after seven years.

Our poorest results obtained were with partial laryngectomy with irradiation. There were 17 cases that refused or were considered poor risks for laryngectomy, and on these cases a partial laryngectomy with irradiation were used with nine recurrences and eight cures. In this group there is one case of cure of nine years; one case, cure of eight years; three cases, cure of five years; one case, cure of four years, and two cases, cure of three years. Total number of cures, eight cases. In cases in which laryngectomy was used for treatment of laryngeal cancer there were 50 patients. In this series there were 13 cases in which there was recurrence. The period of cure shows one case for 16 years; three cases, 13 years; three cases, 12 years; one case, 11 years; two cases, 10 years; two cases, nine years; one case, eight years; two cases, seven years; one case, six years; one case, five years; two cases, four years; one case, three years. The operative procedures in the series of cases were performed in the laryngofissures by myself; in the partial laryngectomies with radium application, the operative procedures were done by me and the radium application by Dr. George E. Pfahler, Dr. Eugene Pendergrass or Dr. Karl Kornblum assisting with the radium application. The laryngectomies were done by a number of operators, some of the cases having gone through the Clinic for check-up only and later sent to another surgeon for removal of the larynx. In this way the results obtained represent a cross-section of the method of treatment and not the results of the individual operator.

I was delighted to learn of the results obtained by Dr. Kramer with Roentgen treatment of cancer of the larynx. I have seen excellent results in a number of cases, particularly where the lesion is extrinsic. I have observed cures over a five-year period with Dr. Pfahler, Dr. Pendergrass and Dr. Kornblum on various occasions in extrinsic cancer. In intrinsic carcinoma, however, the results have not been as good and my impression has been that better results may be obtained by surgery than by irradiation therapy in intrinsic cancer. I do not have definite statistics on irradiation of intrinsic cancer. There are several points with reference to irradiation of cancer of the larynx that are worthy of note:

1. In cases where there has been recurrence following irradiation the recurrence has almost always been at the site of the original lesion.
2. In cases where surgical treatment had been used for excision of the primary lesion the recurrence responded very promptly to irradiation therapy. This was used only in cases where the recurrence was inoperable surgically.
3. Especially good results have been noted in aged individuals with irradiation therapy in extrinsic cancer, that is, in individuals over 75 years of age, where the laryngeal cancer is extrinsic.
4. Recent irradiation methods have produced much more favorable results than earlier methods employed. I have found no published statistics, however, of irradiation in intrinsic cancer of the larynx with five year cures that are comparable to the surgical cures reported by many laryngeal surgeons. Personally, I feel that where intrinsic cancer of the larynx is operable, surgery should be used in preference to irradiation.

